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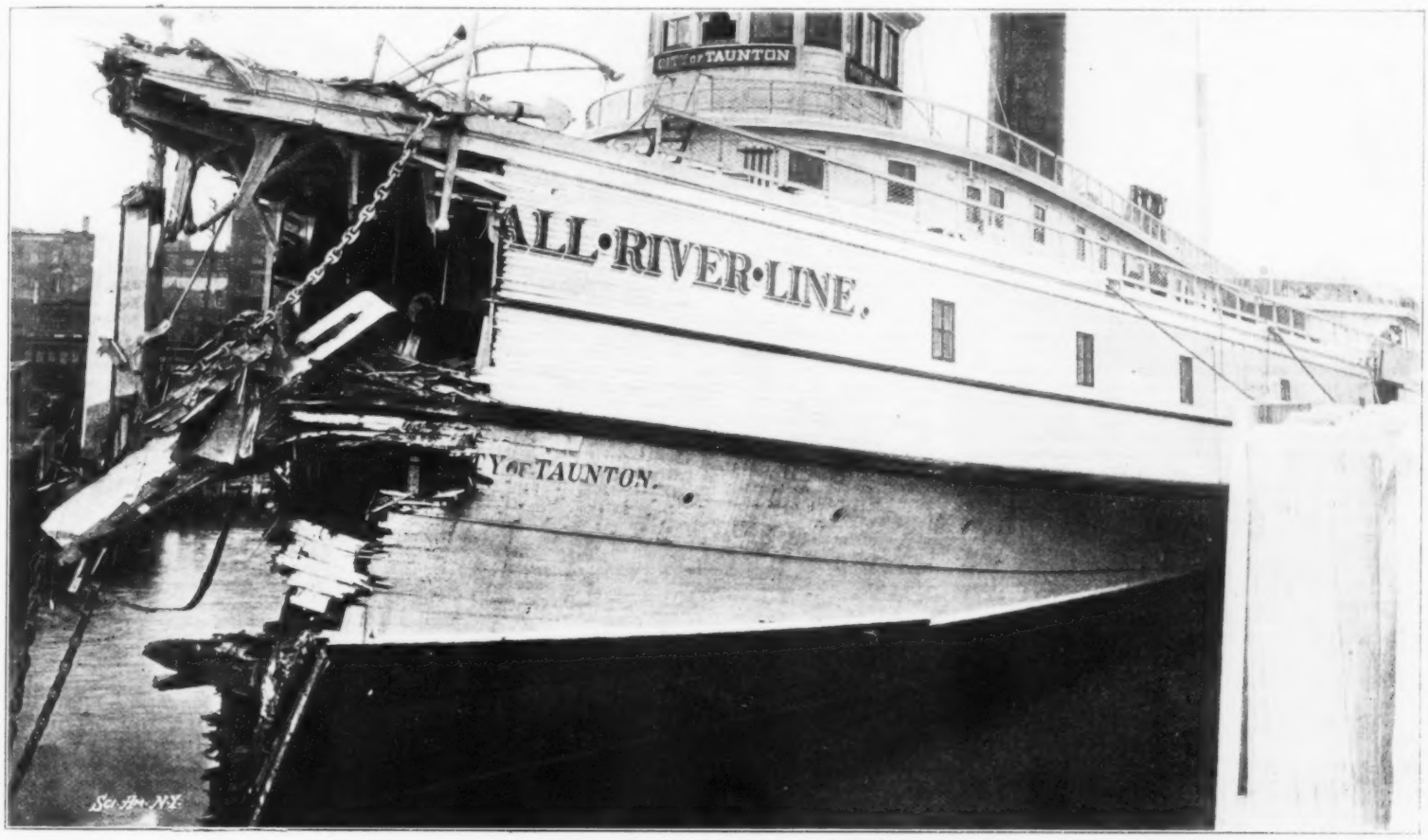
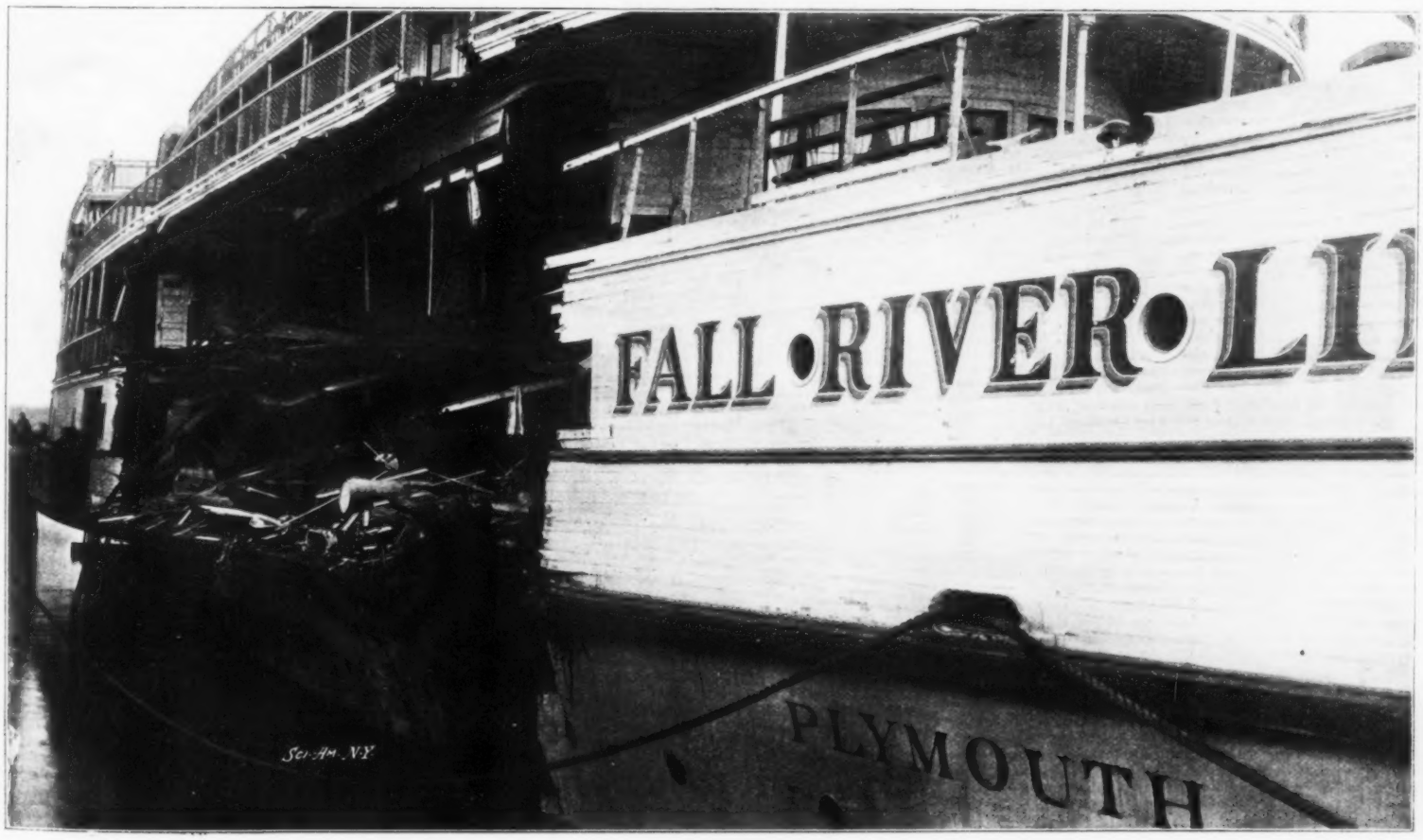


THE BOW OF THE "CITY OF TAUNTON."



THE "PLYMOUTH" AFTER HER COLLISION WITH THE "CITY OF TAUNTON."

THE COLLISION OF TWO LONG ISLAND SOUND STEAMERS.

THE COLLISION ON LONG ISLAND SOUND.*

By C. H. THOMPSON.

THE peculiar accident to the two great Sound steamers, the "Plymouth" and the "City of Taunton," both Fall River Line boats, cannot be attributed to carelessness of the officers or crew of either vessel. Just at the mouth of Long Island Sound conditions are peculiar. The route that it is necessary for deep-draft craft to take lies through a swift-running and very deep channel known as the Race, a narrow portion of the Sound between Little Gull Island and Race Rock Light. In fair weather it is a difficult place to navigate, and every master of a vessel compelled to pass through this waterway is cautious to the extreme, even during the most favorable weather conditions. From the statements of the captains of both of the vessels concerned, the only conclusion to be drawn is that it was accident, pure fate, that drove the prow of the "City of Taunton" into the forward starboard side of the "Plymouth." The illustrations show the force with which the vessels struck. Seven cabins were utterly destroyed on the "Plymouth," and an immense hole was stove in her hull. While all the cabins but one were occupied, only a single passenger lost his life. The other victims were members of the vessel's crew, who occupied quarters in the forward hold. The bow of the "Taunton" shows the extent of her injuries, which were entirely above the water line, though they placed her in considerable danger, because there was a possibility of the waves washing into her. This they did to the extent of almost flooding the vessel's forward compartment.

From authentic reports, the "City of Taunton" and the "Plymouth" approached each other, sounding signals, and steering in the prescribed course, which at the point where the collision occurred is so extremely narrow, that navigators familiar with the locality are sure that it would be something of a feat to pass these huge vessels in the bright sunshine and calm waters of a June day.

It is sure to develop, after careful investigation, that the masters of these craft did everything within the power and thought of capable navigators to save the property of their employer, and also that they took more than ordinary care of the precious lives carried aboard the steamers.

The appearance of these vessels naturally gives rise to the thought that they struck with considerable force—no doubt they did; but it is an acknowledged fact that even when the machinery, powerful though it is, of these Sound leviathans is reversed, their headway is not checked and the momentum not overcome for some time after the backward movement of the wheels has started. This is best illustrated to the lay mind by observing a ferryboat enter its slip. It approaches with the machinery at a standstill; yet the momentum is sufficient to bump it hard against the pier, even when the engines are reversed a considerable distance from the entrance to the slip.

THE INDUSTRY OF COMPRESSED AND LIQUEFIED GASES.

IN the report of the Eleventh Census, Part III., page 279, it is stated that "the use of compressed ammonia gas has reached large proportions in the last decade, and has proven a valuable aid in the preservation of food, the refrigeration of malt liquors, and the manufacture of ice. The introduction of the use of anhydrous ammonia has given great impetus to the manufacture of special machinery adapted to its employment in the departments named. Taken as a whole, its manufacture may be classed as a distinct industry." Although Prof. A. C. Twining,† of New Haven, Conn., had in 1850 received a patent for an ice machine using ethyl ether, or other compressed gas, and had in 1855 a machine of 1 ton capacity in operation in Cleveland, Ohio,‡ and although in 1867, and probably earlier, the ammonia ice machines of Ferdinand Carré were in active operation, this seems to have been the first allusion in the census reports to compressed gases, and no data are there given for them. At the census of 1900 returns were made not only for compressed or liquefied ammonia (known technically as anhydrous ammonia), but also for sulphur dioxide, carbon dioxide, nitrogen monoxide (known technically as nitrous oxide), oxygen, and liquid air, the manufacture being carried on during the census year in 30 different establishments regularly devoted to this business. In addition there were six establishments reported in which liquefied gases were produced as a subordinate part of the product, the major part of the product being in some instances other than chemicals. Besides, one idle establishment was reported. Taking the returns together, it is found that there were 37 establishments devoted to this manufacture, producing $1,220,297 of products and giving employment to 251 wage earners and $2,185,535 of capital.

Of these establishments 19, employing 181 wage earners and $1,650,094 of capital, were engaged in producing liquefied carbon dioxide, and the output for the census year amounted to 12,196,061 pounds, of a value of $708,864. In addition, 1 establishment using carbon dioxide in manufacture reported having produced and consumed 165,000,000 pounds of this gas during the year; but, though it was compressed, it was not liquefied for use. There was employed in the manufacture of the liquefied carbon dioxide reported above, 7,027 tons of magnesite, 2,011 tons of limestone, 774 tons of coke, and 4,771 tons of sulphuric acid, and among other products there were obtained 3,095,000 pounds of Epsom salts, 3,278 tons of calcined magnesite, and 5,000 bushels of lime. About 3,500,000 pounds of the carbon dioxide reported came from fermentation or from effervescent springs.

Ten establishments employing 52 wage earners and $453,328 in capital were engaged during the census year in producing anhydrous ammonia, and the output for the year amounted to 2,443,729 pounds, having a value of $448,157, and there were consumed in this manufacture 2,148 tons of ammonium sulphate, 4,199,708 pounds of aqua ammonia, and 83,402 bushels of lime.

Carbon Dioxide (carbonic acid gas, CO_2).—Carbon dioxide was liquefied by Faraday in glass tubes as early as 1823, through the pressure resulting from the gas being set free from combustion. In 1834 Thilorier operated this method on a much larger scale by the use of wrought-iron cylinders in place of the glass tubes. He discovered that by allowing the liquid to rapidly evaporate the reduction in temperature was so great that a portion of the CO_2 became solid. By moistening this solid CO_2 with ethyl ether he obtained a temperature of —100 deg. C. In 1837 Dr. John Torrey, of New York, liquefied this compound in tubes and applied the liquid to guns as a propellent. In 1844 Natterer invented a pump by which very high pressures were obtained, and through which the liquefaction of carbon dioxide could be better accomplished than by the self-compression method previously used. In all these cases when liquefying carbon dioxide the gas was not only subjected to pressure, but it was also cooled. In 1869 Prof. W. N. Hill, at the United States naval torpedo station, Newport, R. I., proposed the use of liquefied CO_2 in torpedoes. In June-August, 1873,* he made more than 500 pounds of the material, and the manufacture was continued at the station at intervals for some years.

In a private communication from John B. Stobaeus, of Charles Cooper & Co., Newark, N. J., it appears that he began the liquefaction of carbon dioxide on a commercial scale in the United States in July, 1884, and put the product on the market. The gas was generated from magnesite imported from Greece, by reaction with sulphuric acid, and the by-product was Epsom salts. The material was sent to the trade in steel tubes weighing about 27 pounds each, and these tubes were fitted with a valve, having a conical seat, which was invented by Mr. Stobaeus. The books of this firm show that 1,188 cylinders, containing 14,256 pounds of CO_2, were produced in 1885, and 10,704 cylinders, containing 128,448 pounds of CO_2, in 1891. The manufacture has since been taken up by others, and in addition to the method used by Mr. Stobaeus the carbon dioxide is now obtained by burning magnesite, by which magnesia is obtained as the by-product; or dolomite, by which a cement is obtained as the by-product; or marble or limestone, by which quicklime is obtained as the by-product; by treating marl with sulphuric acid; and by burning coke. The carbon dioxide issuing from effervescent mineral springs, and that produced in the fermenting tubs during the brewing of beer, is also collected and liquefied. In all of these processes the gas is washed and otherwise purified before compression.

From the data given by Mr. Stobaeus it appears that the cylinders supplied by his firm held 12 pounds of CO_2 each. The American Carbonate Company, of New York, advertise to supply cylinders in two sizes, containing 10 and 20 pounds of CO_2, respectively, representing 600 and 1,200 gallons of gas, the net weight of the cylinders being 27 and 70 pounds. Several of the companies announce that the cylinders are tested for a pressure of 3,700 pounds per square inch.

Compressed carbon dioxide is used in charging soda water, mineral waters, cider, beer, and other effervescent drinks. By attaching a charged cylinder of the gas, governed by a proper regulating valve, to a barrel of beer or other beverage the liquid is not only continuously charged with the gas, but by the gas pressure the liquid is forced to the point where it is desired to serve it. By its use the old art of "Kraeusen," which consisted in adding to stored beer, as it was being casked or bottled, some beer in the first stages of fermentation, has been displaced. Carbon dioxide is used in the manufacture of salicylic acid and of many carbonates. It is proposed for use as a medicinal agent by inhalation and in baths; for raising dough in the manufacture of aerated bread; as a refrigerating medium; as a buoyant material in raising wrecks or preventing disabled ships from sinking; and for extinguishing fires, R. Ogden Doremus having found that but 20 per cent of CO_2 in the air of the locality where fire exists is sufficient to arrest the progress of the flames. It has been used by the government as a motive power for automobile torpedoes.

Anhydrous Ammonia.—This material is the chemical substance ammonia (NH_3) in a pure and dry condition and in a compressed and liquefied state, and it is manufactured by the distillation of the ordinary 26 deg. ammonia of commerce in a suitable apparatus. This apparatus, which should be of sufficient strength to stand a pressure of 65 pounds to the square inch, comprises a still, a condenser, three separators, and a drier or dehydrator. The still is heated by a suitable steam coil to a temperature of about 212 deg. F., when the ammoniacal gas, together with a certain amount of water, passes off into the first separator, which latter is usually situated on the top, and forms an upward extension of, the still. In this first separator the greater portion of the watery particles carried over are eliminated by a series of perforated plates, through the perforations of which the gas had to pass, and are returned to the still through a dip pipe. From this first separator the partly dried gas passes through a water-cooled worm in the condenser, and then successively through the two other separators to the drier or dehydrator, where it is passed through a set of similarly perforated plates to those in the first separator, but having small-sized lumps of freshly burnt lime placed upon them, by which any moisture that may still remain in the gas is removed, and the completely anhydrous product can then be passed into the ammonia pump or compressor. It is found advisable to work the still at a pressure above 30 pounds to the square inch, so as to admit of the liquid being raised to a slightly higher temperature than the boiling point of water at atmospheric pressure, without causing the water to boil, the result of this being that the whole, or practically the whole, of the ammonia will be set free, while at the same time the least possible amount of the water will be vaporized and passed over with the ammonia gas.

Or it may be obtained from ammonium salts by heating them with lime and treating the gas as above described. The salt usually employed is ammonium sulphate. Aqua ammonia, or ammonia water, is of different strengths, according to the amount of NH_3 dissolved in it, but the standard strength has a specific gravity of 26 deg. Baumé, and it contains 38.5 per cent by volume, or 26.6 per cent by weight of anhydrous ammonia. Thus 3.76 pounds of 26 deg. ammonia will be required to make 1 pound of anhydrous ammonia. An excellent table of yields of anhydrous ammonia from 26 deg. ammonia is given by Ilty‡ I. Redwood.§ The ammonium sulphate or sulphate of ammonia of commerce is reckoned as containing 25 per cent of anhydrous ammonia.

It is believed that some at least of the owners of ice machines produce the anhydrous ammonia that they employ, either in originally charging their machines, or in making good any loss which may take place, but there are no returns on this point. It appears also that there is some anhydrous ammonia imported, the report on "The Foreign Commerce and Navigation of the United States" from the Treasury Department placing this at 14,210 pounds, having a value of $5,870 for the year 1891, but the data for such importations as may have occurred in other years of the past decade do not appear separately.

Although Fourcroy and Vauquelin and, at about the same time, Guyton de Morvéau, announced that they had accomplished the liquefaction of ammonia gas, it is believed that, as they had no suitable means for drying the gas, they failed to obtain the anhydrous ammonia. It was first certainly liquefied by Faraday in 1823, and it was not long before it was being produced in considerable quantities. Larkin and Scheffer began the commercial manufacture in St. Louis, Mo., in 1879.

Anhydrous ammonia appears, as stated above, to have first been used for refrigeration by Ferdinand Carré in his absorption machine, but it was not long before it was employed in compression machines of the type invented by Perkins and Twining, based on the refrigerating principle, which was demonstrated by Doctor Cullen in 1755; and although it has had to compete with ethyl ether, carbon dioxide, sulphur dioxide, and air, it is to-day the material which is most largely used in ice machines, and this is the principal use for this substance, though recent researches indicate that other uses will soon be found for it in chemical manufacture and in other arts.

Sulphur Dioxide (sulphurous acid gas, SO_2).—This substance is produced by burning sulphur in air or oxygen, 1 pound of sulphur giving 2 pounds of sulphur dioxide. It was liquefied by Monge and Clouet about the beginning of the nineteenth century. The liquefied sulphur dioxide is now a regular article of commerce, and is sent into the trade in glass "siphons" and in iron flasks, as being a convenient means of transportation and storage of the substance for use in chemical laboratories and in manufacture. The liquid has found some use in ice machines. The substance is used as a reducing agent, as a bleaching agent, and as a disinfectant. Hardin† states that at present (1899) "about 4,000,000 kilogrammes of this liquid are being prepared annually."

Nitrogen Monoxide (hyponitrous oxide, nitrous oxide, laughing gas, N_2O).—This body is prepared by heating ammonium nitrate to a temperature not exceeding 258 deg. C., when the gas is evolved. It is carefully purified, well washed, and then compressed in steel cylinders. This gas was first liquefied by Faraday in 1823. The Lennox Chemical Company began the liquefaction of the gas for the trade at Cleveland, Ohio, in 1883. The exhilarating properties of the gas were discovered by Sir Humphry Davy, who was the first to inhale it, in 1809, and it then received the name of laughing gas. It is now used as an anesthetic agent in minor surgical operations, especially in dentistry, its use for this purpose having been suggested by Dr. Horace Wells, and it was first applied to him in the extraction of a tooth at Hartford, Conn., December 11, 1844.

Oxygen.—This gas, as commercially supplied in the compressed condition, is produced by heating potassium chlorate mixed with black oxide of manganese. It is sold in the market for use in medicine by inhalation, when it is usually mixed with nitrous oxide, essential oils, and other bodies which are believed to possess therapeutic qualities. Liquid oxygen is not known to be produced commercially except as referred to under liquid air, but it was the first of the so-called permanent gases to be liquefied, this having been independently effected by Pictet and Cailletet in 1877.

Liquid Air.—Atmospheric air is a mixture of approximately 21 per cent of oxygen and 78 per cent of nitrogen by volume, with ninety-four one-hundredths of 1 per cent of argon, about four one-hundredths of 1 per cent of carbon dioxide, and variable quantities of water vapor, ammonia, and other bodies, according to locality and conditions. After 1823, when Perkins‡ erroneously believed that he had liquefied air, numerous unsuccessful attempts were made to accomplish this result, but in 1877 Raoul Pictet and Louis Cailletet, working independently in Switzerland and in France, achieved the result on a small laboratory scale, and it was later repeated by Wroblewski, Olszewski, and Dewar, who improved the methods so as to notably increase the yields, and in 1893 Dewar froze air into a clear, transparent solid. The liquefaction of air on an industrial scale began about this time with the invention of the machines of Linde, Hampson, and Tripler, and later those of Ostergren and Burger, Dewar, Kuhn, Chase, Code, O'Doherty, Johnson, and others.

The methods may be classified as the cascade method of Pictet, Cailletet, Wroblewski, and Onnes; the self-intensive motor method of Siemens, Kuhn, and Johnson; the countercurrent free-expansion system of Linde, Hampson, Tripler, and Ostergren, and Burger; and the self-intensive work method of the American Liquid Air Company, known as the Ala system. Emmens‖ states that the principal features of the method by which the liquefaction of air can be effected on a commercial scale were clearly described in the specifi-

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

† Barnard's Report on Paris Exposition of 1867, pages 368 to 386.

‡ Refrigerating and Ice-Making Machinery, page 24.

* Liquid Carbonic Acid, page 4.

* Theoretical and Practical Ammonia Refrigeration, page 113.

† The Rise and Development of the Liquefaction of Gases, page 234.

‡ Annals of Philosophy, vol. 6, page 66.

§ Liquefied Air, page 2.

cations of British patent No. 2064, granted to Charles William Siemens in 1857.

Owing to the complex composition of air, several different products are obtained by its liquefaction, notably liquid oxygen and nitrogen and solid carbon dioxide. Pictet has invented a separator by which these bodies may be rapidly separated for use, and there is thus drawn off at —70 deg. F., solid carbon dioxide; at —290 deg. F., commercial oxygen gas of 50 per cent purity; at —296 deg. F., oxygen gas of 99 per cent purity; at —300 deg. F., liquid oxygen and nitrogen gas of 95 per cent purity; at —310 deg. F., nitrogen gas of 99 per cent purity; at —312 deg. F., liquid air; and at —316 deg. F., liquid nitrogen.

While many commercial uses for liquid air have been proposed, it is not known to be so used at present. It may, however, be now looked upon as a source of oxygen which promotes combustion and enables man to obtain high temperatures and high illuminating power, but it is not yet proved that this method of heating and lighting can compete economically with electricity. Liquid air does enable man to readily obtain low temperatures, which can be usefully employed in chemical operations, and a continually extending use may be looked for in this direction. Elihu Thomson has pointed out that it may possibly find a useful application in increasing the efficiency of conductors of electricity.

Chlorine.—This gas, which may be produced by the action of muriatic acid on black oxide of manganese or by the electrolysis of common salt, is produced commercially abroad in the liquid state, but no returns are made of it in this country. It is used in chemical manufactures and for bleaching and disinfection. It is sent out to the trade in iron cylinders.—Census Bulletin 210.

CALLIYTPE: A NEW PRINT-TYPING SYSTEM.*

By JACOB BACKES.

RECENT improvements in the line-spacing provisions of all the leading typewriting machines, whereby the distance between the typed lines can be easily and rapidly regulated, obtaining results corresponding to the printer's single and double leading, together with the steady development of the line-engraving art and industry, continually suggest the practicability of applying line-engraved typewritten matter for direct printing purposes without recourse to typesetting or linecasting. The possibilities in the line of making such line-engraved blocks serve as substitutes for regular typographical print-typing are now systematized and made public under the name of callitypy.

In callitypic type-composition the print-typing plant consists of one or more writing machines of any standard make, in good condition as to alignment, clearness of type-impression, and black-record inking;

BY STRIKING any desired character over any other charac ter, while the space bar is held down, numerous combina tions can be Callityped for any modern European language. Thus:

Received of John $ a b c A B

ILLUSTRATION 1.

sheets of white paper, square, ruler, firm white cardboard, paste, pen and ink—in short, no other material is required but what is already to be found in any library or well-appointed editorial or business office. Regular correspondence and callitypic type-composition can be done interchangeably on the same machine without any change of type or readjustment of parts, as the practical application of callitypic principles is a matter mainly of adapted type-writing, not of particular mechanism.

At least four-fifths of the writing machines in actual successful use write, exactly or approximately, six solid lines to the inch, and ten letters or spaces to the horizontal inch; these actualities of line- and letter-mechanism form the basis of callitypic type measurements and terminology. Different sizes of type, from the regular typewriter pica through the finest gradations down to microtypes, are produced by grading the degree of reduction in the line-engraving. For instance, if 36 lines of solid typewriting, extending perpendicularly about six inches, are reproduced in the exact size of the original, the printing from the block is called sixto, because the lines of type are six to the inch. If 42 lines (one-sixth more) are reproduced in the same space of six perpendicular inches, the height of each letter is only six-sevenths as much as in the sixto, and the smaller type is called sevento (seven lines to the inch). If 48 lines are reproduced in the same space of six inches, the block would print in eighto, eight lines to the inch. Thus it is seen that the method of producing any size of type for any size or proportion of page or column results from the application of rule-of-three principles. The system is simplicity itself, compared with the old one based on fixed points and variant ems, and the terminology is self-defining.

To produce sixto, order from the line-engraver an exact fac-simile of the original.

To produce sevento, (Illustration 1) typewrite the matter one-sixth longer and one-sixth wider than the printing size desired, and order from the line-engraver a reduction to that printing size.

For eighto, type the matter one-third longer and one-third wider than the printing size desired.

For nineto, type the matter one-half longer and one-half wider than the printing size desired.

For tento, type the matter two-thirds longer and two-thirds wider than the printing size desired.

For elevento, type the matter five-sixths longer and five-sixths wider than the printing size desired.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

For twelveto, type the matter twice as long and twice as wide as the printing size desired.

Smaller sizes, to type so fine-faced as to be illegible, are produced by the same method. However, when proficiency in the practice of the art has been obtained, the operator does most of his work without any particular reference to any system of sizes; he simply callitypes in the proportion of page or column wanted, and orders the matter reduced to the desired size.

All the illustrations made for this article were done on one machine, without any change of type or mechanical equipment on it at any stage, and any useful or ornamental effect produced in any size can be produced just as easily in any other size.

The original typewritten matter for Illustration 1 (sevento) measured 3½ by 2¼ inches. The initial

Some feelings are to mortals given
Containing less of earth than heaven.
And if there be a human tear,
From passion's dross refined and clear—
A tear so limpid and so meek
It would not stain an angel's cheek—
'Tis that which pious fathers shed
Upon a duteous daughter's head.

o: white • black ◎ and ◉ : kings

~~B. TO PLAY AND WIN. W. TO PLAY AND DRAW~~

ILLUSTRATION 2.

letter was inserted in this way: It was sheared from a discarded black-printed book, and measured by placing it against a page of solid written typewriting and noting how much space it covered. That amount of space was left blank in the typewritten page, which, when completed was pasted on a mounting cardboard and the initial letter was pasted in its proper place. In the same way as the initial, any black-printed trademarks, maps, diagrams, music, difficult tabulated matter, imprints, clipped Chinese or Arabic matter can be pasted alongside of the typed matter wherever space is left for the insertion, and all is reproduced on the same printing block, avoiding the necessity of justifying cuts. The significance of this procedure is perceived when it is realized that good press proofs of initials, etc., will answer the purpose of expensive type-founders' metal; and that large letters can be pasted alongside each other, forming displayed matter.

The original of Illustration 2 (eighto) measured 4 by 2¾ inches. The ornamented characters in the poetical selection were produced by supplementing the work of the writing machine with pen and ink. The

MARCH								APRIL						
Su	Mo	Tu	We	Th	Fr	Sa		Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7		--	--	--	1	2	3	4
8	9	10	11	12	13	14		5	6	7	8	9	10	11
15	16	17	18	19	20	21		12	13	14	15	16	17	18
22	23	24	25	26	27	28		19	20	21	22	23	24	25
29	30	31						26	27	28	29	30	--	--

ILLUSTRATION 3.

black squares were produced by striking M's over X's. All horizontal ruling was produced by successive strokes on the underscore key. The perpendicular lines were made with pen and ink.

The original typewriting of Illustration 3 (nineto) measured 4½ by 1½ inches. The callitypic system is adapted peculiarly for the production of tabulated matter, for these reasons: First, the most intricate perpendicular or diagonal rulings, difficult and time-consuming in typographical practice, are, in callitypy, produced neatly and expeditiously with pen, ink, and ruler; second, estimates are facilitated by the fact that the number of characters of any size, to go in any length of line, is precisely and immediately determinable in advance, all the characters and spaces occupying the same horizontal space.

Illustration 4 is in twelveto, and is self-explaining.

Callitypes can be printed by any printer, whether they are exclusively in the form or are used in combination with linotyped or hand-set matter, and as many impressions can be taken from them as from movable type or line-cast matter. Callitypes weigh only one-sixth as much as the same matter set in movable type or line-castings.

Lines slanting in any desired direction may be produced by typing the original matter in a stairway form, cutting it out and pasting it in any direction.

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ILLUSTRATION 4.

The system lends itself particularly to the production of matter typed inside of fancy borders and with embellishing initials, as a search through discarded catalogues, advertising pages, and other displayed printables will discover an endless quantity of unmonopolized material which can be clipped out and utilized.

Line-engravers are established in every large city, in all civilized countries. The charges for callitypes in the United States range from 3½ to 8 cents per square inch, the figure being dependent on locality, amount of work handed in at a time, kind and condition of copy, etc. In considering the cost of callityping matter, it should be borne in mind that the system favors small type and close-spaced lines, for there is less routing to be done in that kind of typed matter; and that the rate per square inch is the same, whether the type is sixto, twelveto, or eighteento. In the last-mentioned size nine times as many words as in sixto can be set in any given space.

All line-engraving reductions reduce length and width in the same degree, and all reductions, to whatever size, retain the type characteristics of the original matter.

Counting five letters and one space for each word, a callitype one inch square will contain the following number of words in different sizes, the estimate being based on solid prose matter, and the figures being the nearest whole number: sixto, 10; sevento, 14; eighto, 18; nineto, 23; tento, 28; elevento, 34; twelveto, 40; fourteento, 54; sixteento, 71; eighteento, 90; twentyto, 111.

SOME IMPROVEMENTS IN SOAP MAKING.

SOME of the changes which have been brought about during the last thirty years in the soap trade are quite remarkable, and many of the methods used a generation ago have disappeared and have been superseded by new manufacturing processes. Never before had invention made such enormous advances as find themselves concentrated in the time first mentioned. All other industries have been similarly affected, but the soap trade can claim more than an ordinary share in the developments of modern industrial life. Some of the changes have been brought about by natural growth and a progress which is inherent in the nature of all trades; other changes were influenced by the advances in other industries which reflected on the soap trade and brought materials and methods to light which were intended for other materials, but were found useful for soap-making, and thus led to their embodiment in the methods of soap production.

The materials used for the production of soap have on the whole not changed; they are still the same ingredients they were thirty years ago and only few changes with regard to them can be recorded. There are still the same kinds of fatty substances and the same kind of alkalies as the main basis of all soap production. Palm oil, cocoanut oil, tallow, and lard are, and surely will for long remain, the principal fats for soap, and it must be stated that these fats and oils are now of much better quality than they ever were before. The impurities formerly to be found have disappeared and what was hitherto unknown has come to light, and can be ascertained without much trouble and expense. Not only the increased knowledge and greater control, but also competition and the desire for health have greatly helped the advance and sustained the efforts which so unceasingly and with such perseverance were made to find out what is best for the soap production. The progress which has been made in the knowledge of the chemical contents of the fats has enabled the oil manufacturers to produce the oils in a much purer and better quality; the improved raw materials have at the same time the advantage of not having risen in price.

Cottonseed oil has probably undergone one of the most remarkable changes in the indicated direction, and what was once little known has now become one of the most important raw materials and ingredients. No good method for refining cottonseed oil was known thirty years ago; it had as crude oil a dark red and muddy looking appearance, and as no process had come to the knowledge of the trade which altered the impurity, the soap manufacturers fought shy of it, and did not place much importance on its improvements. Considering that now the same oil can be prepared and refined to be of a very pale color, the advance can truly be called enormous, and no wonder that it has become a most important factor in the soap fat supply, where it holds a very high position.

The bleaching of fats for use in soap has also become a great factor, without which the advance of the soap industry would not have been so quick and complete. With the application of ozone and ozonized air soap fats have been bleached in recent years, and the process proved to be a great success. By means of this ozone process, colored fatty substances, as for instance palm oil, are easily obtained of a white color. Besides which advantage there is the further addition and the even better improvement that the oil is freed from all deleterious acids and other chemical products which could be retained in the oil, and these impurities had hitherto done untold harm where they remained unknown. The new process has thus done much to bring pure fatty substances on the market.

Of the greatest influence on the advance in the use of soap has been the development in the production of all kinds of toilet soaps, of which such large quantities are daily required. The people have been taught to use soap, and the masses of educated people purchase only scented and colored soaps made purposely for toilet purposes and so got up as to attract attention. Even the working classes use now mostly colored soaps for their ablutions, and the ordinary white and yellow soaps have been relegated to the wash tub, and for scrubbing and cleaning purposes. Scented and colored must toilet soap now be, and naturally this has in its turn led to an enormously increased demand for perfumes, whose use has grown in quantity and variety. Two or three ordinary and inexpensive perfumes were thought sufficient about twenty years ago and the variety satisfied then all the demands. Now there are at the very least over thirty different perfumes employed, and some of them are not only rare but also very expensive. On the other hand, many perfume imitations have been invented to be used for making toilet soaps, and there is a whole industry which now employs its whole energies in supplying the scent material for soap makers. And then the enlarged range of dyes! Since coal-tar dyes have become known all limits for coloring soap have disappeared and the coal-tar dyes have placed in the hands of soap-makers the easiest means for producing the greatest variety of color effects, of which means the industry has hitherto made most ample use. To look at the color table of a toilet soap traveler, or at the shop window of a fashionable soap

retailer is to find all hues of the rainbow faithfully reproduced. And nobody can deny that this has not been real progress.

But one thing has been of greater influence on the changes which have been witnessed during the last thirty years in the soap-making process as an outside influence, and this is the advance which can be reported from the manufacture of explosives, and among all the modern explosives there are particularly those containing as a basic element the well-known material nitroglycerine. Since glycerine has become such an extremely fashionable ingredient, and the demand for the material grew so enormously, many soap-makers have started to obtain the material from their waste soap lyes, which, as everybody connected with the soap industry knows, contain a large quantity of glycerine which has been extracted during the boiling from the different fats which have been used. Glycerine extraction was at the beginning not an easy matter, and many difficulties had to be surmounted at repeated attempts. Many chemical and other methods were invented and tested to find a proper process to abstract the glycerine in a pure condition, and the degree of purity proved the stumbling block for many otherwise excellent methods. It, will therefore be interesting to look for a moment how the matter has been settled and what method was at last devised to suit the purpose to obtain a pure glycerine out of soap lye, which always contains certain impurities.

In the improved process of alkali making was at last found an assistance which served materially in the development of glycerine extraction and the two processes of so great influence were invented at nearly one and the same time. The cheapest alkali obtainable was used by all soapmakers about thirty years ago, and the cheaper the price the more eager the manufacturers were to purchase; since purity was at that time considered as of no importance. Several of the more important soap manufacturers produced their own alkali, and among these it was a universally observed rule to causticize and use black ash lye without an attempt to purify the liquor. To make glycerine, the impurities associated with the ingredients of these cheap and low grade alkalies were found to be of importance and the removal of these material substances from the waste of the soap lyes was found to be a very difficult matter. With the gradual improvement in the production of purer alkalies, which have to-day reached a point that quite pure alkali can be obtained, the extraction of glycerine equally improved, and gradually chemically pure alkali has permitted the production of excellent glycerine. As soon as the improved alkalies came to be used in the making of soap it was found that the formerly perceived great difficulties were mastered by the chemical operations. No soap manufacturer who desires now to extract all the glycerine contained in the waste soap lye will use anything but the purest fats and the cleanest alkalies for the making of his soap. Only a good quality of raw glycerine and a chemically pure product is to-day marketable, especially as glycerine is now of great industrial importance to soap. On this basis rests also to a great extent the reason for the improved quality of soap seen to-day when compared with the product of former times and the production of the cheap soaps is slowly declining since nobody has any use for them. Twenty-five years ago mottled and low grade filled soaps were largely purchased by the middle and poorer classes, which buy now a better quality for a cheaper price, and even for the lowest grade of work a better kind of soap is now preferred.

These are undoubtedly advances in soap making, and although the manufacturing process is not yet perfect, it has reached a stage when improvement becomes more and more difficult, since a product is now brought forward which leaves little to be desired. —Oils, Colours and Drysalteries.

A WATER SUPPLY FOR JERUSALEM.

DURING the year 1901 a thorough water system upon modern lines was carried out in the city of Jerusalem. The water is conveyed through iron pipes from a spring situated about seven miles distant, south of the city, and known as the "Sealed Fountain" of Solomon's times. The necessity of providing an efficient up-to-date water organization was impressed upon the civil authorities of the city last year by the threatened water famine, which was only prevented through the timely assistance of the railroad company. To guard against any such disaster at a future time, a petition was forwarded to Constantinople asking permission to utilize a portion of the revenues of the religious endowments for the purpose of providing Jerusalem with a water supply. The request was granted and £T.6,000 were set aside for carrying out the enterprise. A commission of local officials was formed to supervise the undertaking, and an engineer from the Public Works Department at Constantinople was employed to carry out the work. A portion of the old stone aqueduct known as "Solomon's Aqueduct" was used at parts where it could easily be repaired, but for the greater part of the distance nearly seven miles of 4-inch iron pipes have been laid down. The undertaking was fulfilled by a local German contractor, who signed a contract with the municipal authorities for furnishing the requisite number of pipes from Antwerp in Belgium at 94 cents the meter, c. i. f. Jaffa. The work was carried out with energy and expedition, although the pipes were hastily laid, and was completed by November 27, the anniversary of the Sultan's birthday, when the inauguration ceremony took place. Two public fountains have been erected, one within the city, in the inclosure of the Great Mosque, and another outside the walls for the use of the inhabitants. The supply of water is, however, far from adequate for the requirements of a city of the size of Jerusalem, but is a boon to the poorer classes, and in times of scarcity of rain will help to avert such a water famine as Jerusalem was threatened with last year.

[CONCLUSION.]

THE NAVAL WAR-GAME WAR.—XIV.*

By FRED T. JANE.

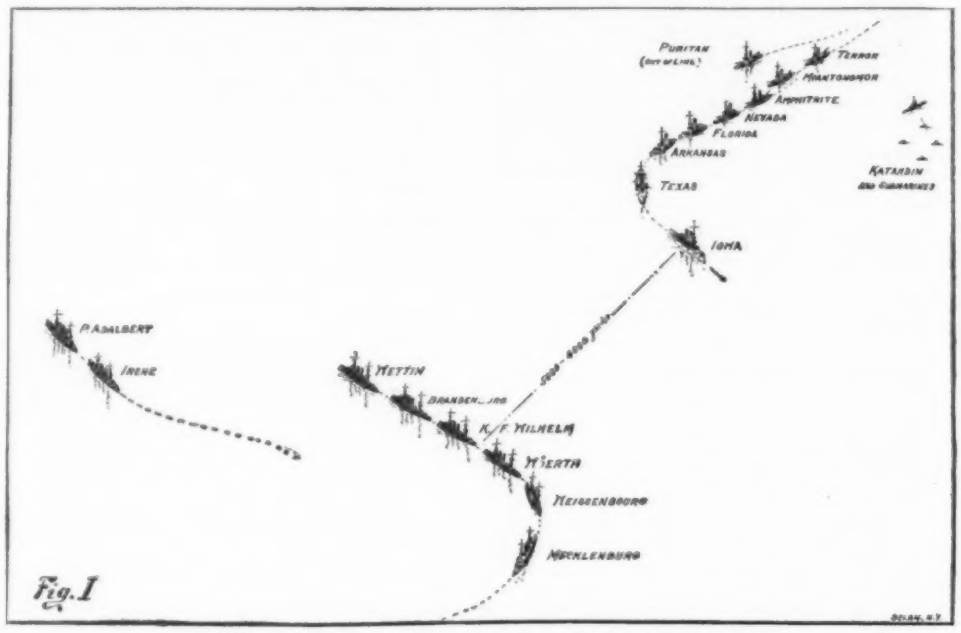
MONITORS AND SUBMARINES IN ACTION IN THE FINAL BATTLE—VICTORY FOR THE AMERICAN FLEET.

THE American fleet was formed into a single line, led by the "Iowa," the "Texas," "Arkansas," "Florida," "Nevada," "Puritan," "Amphitrite," "Miantonomoh," and "Terror" following. The weaker monitors were kept astern, so that they should not come into close action until the first edge of the enemy's fire should be reduced. The "Katahdin" and submarines kept off the off side.

The German formation—also line ahead—was as follows: "Wettin" (flag), "Brandenburg," "Kurfurst Friedrich Wilhelm," "Woerth," "Weissembourg," "Mecklenburg," with the "Prinz Adalbert" and "Irene" as a detached squadron a little ahead and further from the foe.

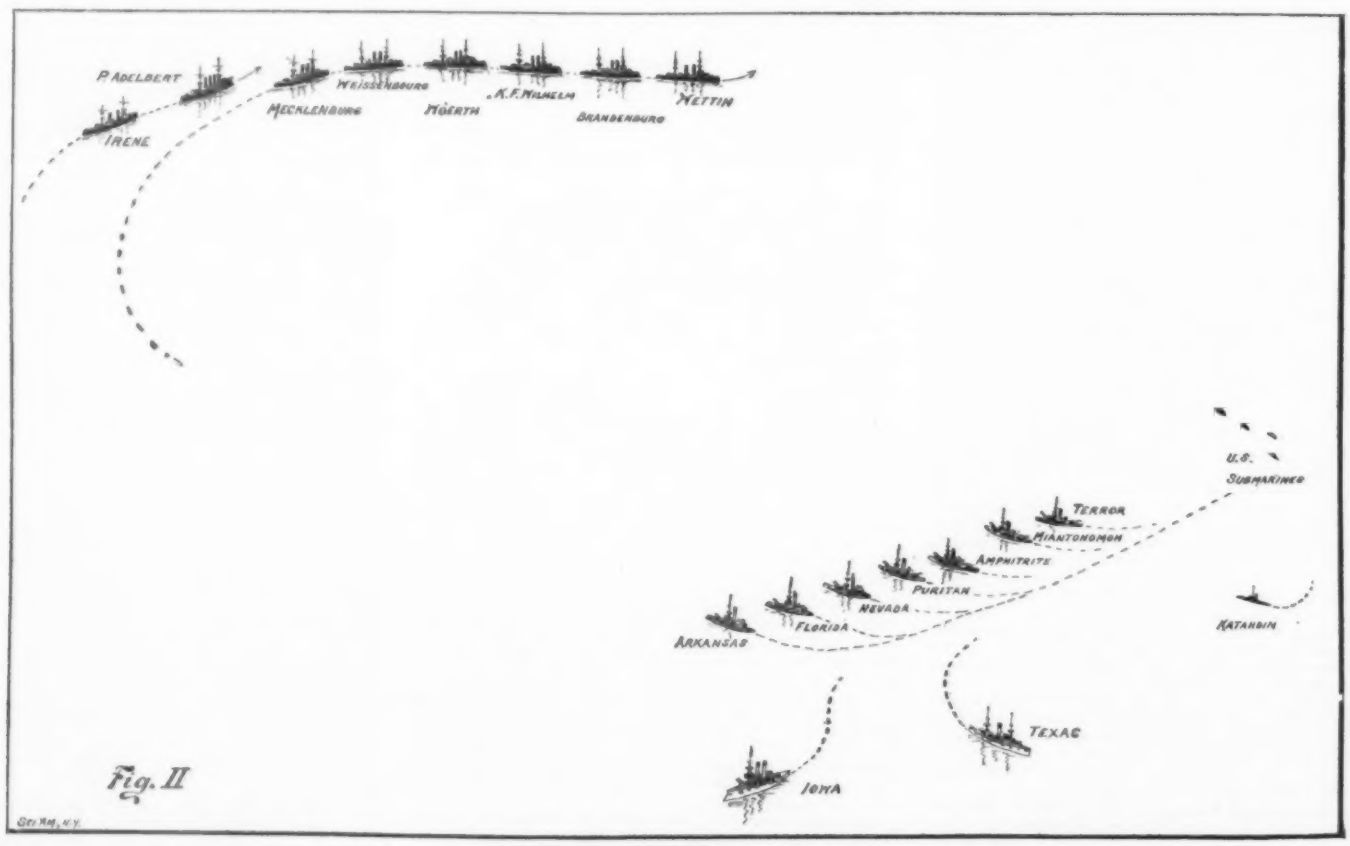
The speed of the Americans was 7½ knots; the Germans maintained just double that—15 knots.

The fleets met almost bow to bow, the Germans circling as range was reached. By this means every ship got a fire into the "Iowa" and "Texas," which, hampered by having to keep with the monitors, were un-



OPENING STAGE OF THE FINAL BATTLE OF THE WAR.

* Prepared especially for the SCIENTIFIC AMERICAN by the well-known naval expert and inventor of the naval war game; with exclusive rights in the United States and Great Britain. This series was begun in the SCIENTIFIC AMERICAN SUPPLEMENT of December 20, 1902.



SECOND STAGE OF THE BATTLE.

able to turn away quickly enough to bring the latter into action. So it came about that "first blood" cost the American fleet its two battleships, which were totally disabled right away. The Germans on their side suffered comparatively little, but two 12-inch A. P. from the "Iowa" almost wiped out the "Wettin's" R.F. battery.

Having delivered their fire, the Germans circled away out of range. When they returned, the tail of the American line was their attack.

To meet this the American admiral gave up steaming altogether, using his ships as floating batteries, except that their screws were used to keep them turning from bows on to broadside and back again. By this means the bow turrets were constantly in action, while the after ones in such ships as had them secured a relative amount of protection.

Across the zone of heavy gun fire thus formed the Germans came. They concentrated on the weaker monitors, and gradually sank them, but only very gradually, for they were very hard to hit. By the time they had done so, all four "Brandenburgs" were in a bad way, and the "Prinz Adalbert" little better. The "Irene," hit by two 12-inch shell, disappeared altogether. Then it was that the "Katahdin" ram came out; but as the very first hit cut away her smokestack, her speed, never great, became very low, so that the still militant Germans, having the speed advantage, easily avoided her. She might, it is true, have acted against the disabled "Brandenburgs," but her orders were to worry the ships still in action. In the end a lucky 9.4 ripped up the "Katahdin," and she sank.

By this time both sides were tolerably impotent, but what was left of the Germans got round astern of the three remaining monitors. These—all of the "Arkansas" type—had either lost their big guns or were unable to turn. Their topsides were blown to pieces, but their belts being still sound they floated all right. The Germans were too far gone to use torpedoes, and few if any big guns remained to them. One or two R.F. still fired, but these had long ago done all that they could. As a last forlorn hope, the Germans tried to end the deadlock with the ram.

To do this more effectually, they first of all stopped, so as to get into some kind of line. This gave opportunity to the four submarines, which the Germans had never suspected, and the Americans given up as lost. Indeed, the "Florida" and "Arkansas" had hoisted white flags, when the first submarine rose alongside the "Wettin" and disposed of her. The "Mecklenburg" and "Woerth" were similarly disposed of before the Germans realized their danger. Then they struck—there being nothing left to do. Before this happened, however, the "Mecklenburg" had managed to drift into and ram the "Nevada"—both these ships going down together. This final stage of the battle is graphically depicted in the engraving on the following page.

A summary of the guns engaged is as follows:

	12 in.	11 in.	10 in.	9.4 in.	8 in.	6 in.	4 in.	3.4 in.
U. S. A.....	14	—	16	—	8	6	26	—
German.....	—	24	—	8	4	46	24	68

The Germans, therefore, had some slight preponderance in big guns and an enormous advantage in R.F. pieces. They were, however, larger targets, and this completely neutralized the R.F. advantage. More than half the German R.F. went at once; the remainder did all the harm they could do, and still left the modern monitors afloat. But for the submarines, however, Germany would have won—these turned the scale completely, and only the "Brandenburg," "Weissembourg," and "Prinz Adalbert"—all badly mauled—escaped.

This ended the "war"—it not being considered advisable to play things out further.

The net result was a draw perhaps—but a draw decidedly in favor of America, which was left with two effective battleships of the "Maine" class. Germany had only the "Schwaben," which was not allowed ready till this stage, and the coast defense ships, unable to cross the Atlantic.

No exact record of incidental losses was attempted, but a scale of ratios and percentages was made out. By this—the scale being from 100 to 0—the losses to commerce and so forth thus appeared:

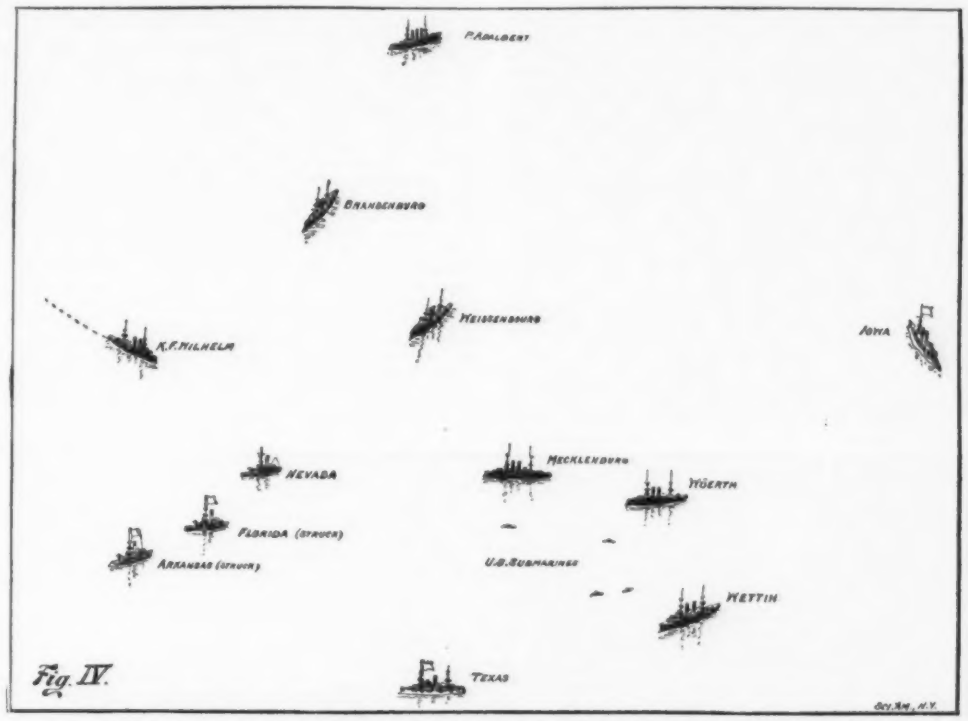
Commerce:	U. S. A	60
	Germany	25
Coast property, etc.:	U. S. A	40
	Germany	0

The U. S. A. also lost one base (Havana); but it was umpired that this would have to be evacuated again by the Germans or recaptured easily enough. The German attempt on another U. S. base (Manila) was, it will be remembered, a failure.

The umpires' report was to the effect that, though other strategical dispositions might have been made, those undertaken were carried through very well and (taking all circumstances into consideration) without very serious errors on either side.

The final action was not noted as a tactical error of moment, it being held that it was essential for Germany to defeat the American fleet before the arrival of the "Maines." An attack on the "Maines"—for reasons referred to last week—was not indicated as a better move.

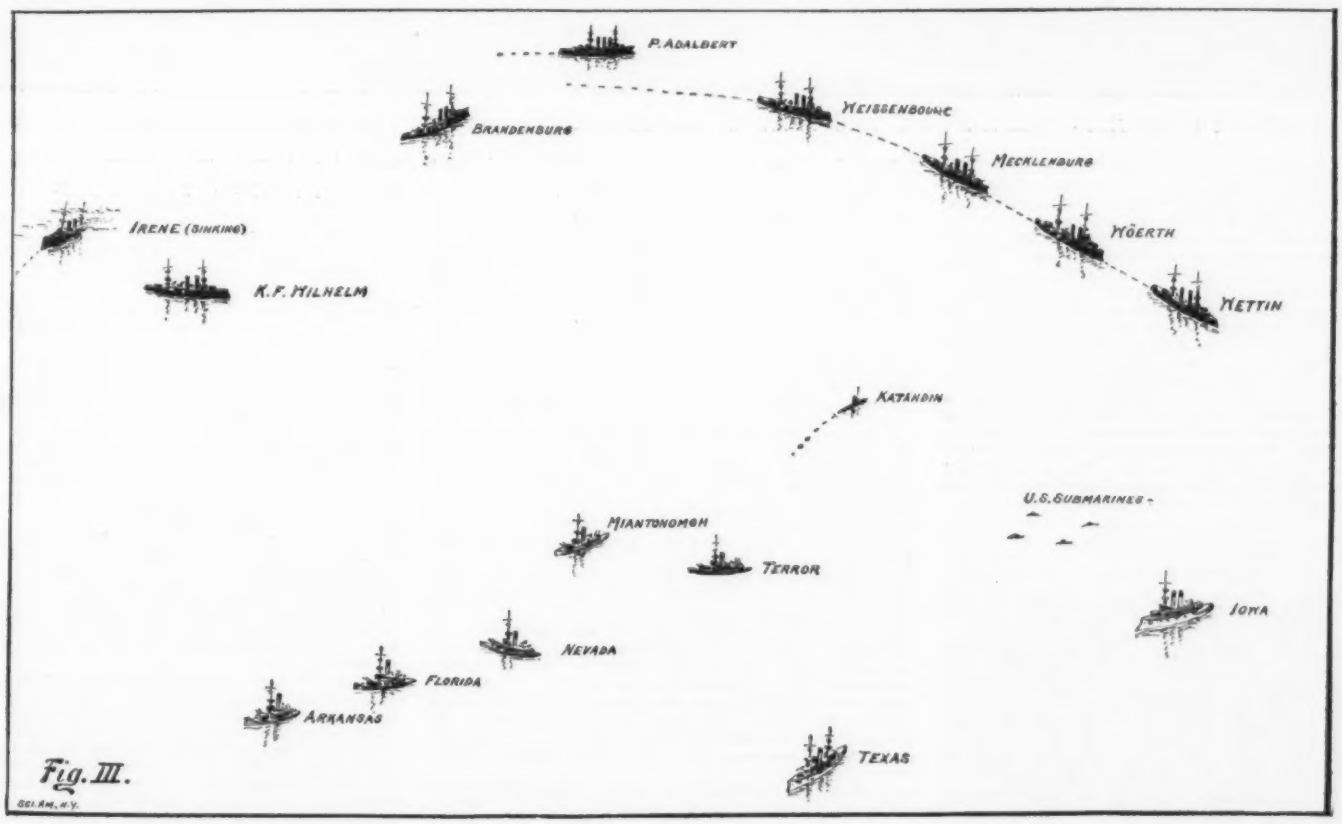
A spell of "fine weather" alone allowed the monitors and submarines to operate; still this was in the chapter of reasonable accidents. The Germans were sure of winning—overlooking the advantage that the monitors possessed in the way of being small targets. Finding this to be the case, the umpires suggested that, since the final battle had to be fought, the Germans would not have been wise, believing as they did, to have continued an evasive war that offered no further advantages. The limit of coast damage was reached. The cost to America was very great, but it was not an unbearable cost, nor could it increase. Thus far Germany failed. But in so far as America was left totally unable to operate against the German coast, she, too, failed. It was assumed that, things having reached this deadlock, peace would probably ensue; or if not, that the conduct of further operations would not be of an instructive nature. No one perhaps had any clear idea as to what further operations would be; so there was readiness to accept the umpires' verdict that America would recapture Havana and probably obtain possession of Kiao-Chau. Some of the German side argued that they could with the "Schwaben" and repaired ships scrape together a force to insure the relief of Havana and the further destruction of American trade, but the umpires negatived the claim on the grounds that the Atlantic voyage could not be undertaken in the face of the American fleet that remained.



FOURTH STAGE. MONITORS STRIKING, SUBMARINES TO THE ATTACK.

FULTON'S SUBMARINE.

It is generally known, says the Matin of Paris, that the first submarine boat was invented by Fulton, but it is not generally known that there was anything practical in his invention. This was an error, as shown in two recent publications from a retired lieu-



THIRD STAGE OF THE BATTLE.

tenant of the French navy named Duboc and from M. Fontin, the librarian of the ministry of marine at Paris. The latter, after a careful perusal of the archives at his disposal, quotes several official reports from witnesses of the performances of Fulton's submarine boat, and concludes by saying with Lieut. Duboc that "the submarine of 100 years ago presented very nearly the principles adopted in modern submarines and also in the Whitehead torpedo." The "Nautilus" of Fulton accomplished feats of great daring.

Fulton, supported by the great savans Monge and Laplace, had to fight against the bureaus of the marine office, against the minister, Admiral Decrés, and against "that ass, the First Consul, who then missed his fortune," meaning by this the certainty of crossing to England with his army at the camp of Boulogne. In August, 1801, Minister Decrés gave orders for sending away from Brest Fulton, with his boat and his torpedo, though he had used them successfully to blow up a derelict in the presence of the French officials. He experienced similar treatment in England, where he went after his failure in France, and where, under the eyes of Admiral Holloway, Pitt, and Lord Melville, Fulton's torpedo boat blew up the brig "Dorothée," which was thrown 6 feet in the air and fell back broken in two. But that treatment was to be expected from the greatest naval power of the world; and when Fulton, proud of his success, presented himself to the First Lord of the Admiralty, the latter said to him: "Pitt is the greatest fool that has ever existed for encouraging a kind of war quite useless to those who are masters of the sea, and who would be deprived of this supremacy if that method of warfare succeeded."

Fulton, with his "Nautilus," measuring 6½ meters in length and 2¼ meters width, went down the Seine to Havre, using a screw moved by hand. The boat submerged at will, through the introduction of a certain quantity of water; it ascended again through the expulsion of the liquid ballast with a pump. Later he adapted at the bow a screw with horizontal blades, which allowed his boat to maintain itself at a constant level. There were other improvements. Fulton knew the depth in which he was, thanks to a kind of barometer registering the weight of the corresponding water columns. The position of the enemy was observed through a cupola having ports and raised just on the level of the water. The crew was composed of three men, captain included. They could stay under water "with two lighted candles" theoretically during six hours, and practically three hours. To blow up a vessel the "Nautilus" went underneath it and sent into it a barbed harpoon to which was attached a torpedo. The submarine boat had a mast and a sail, for its progress on the surface, and they could be drawn inside the vessel in a few moments owing to an ingenious mechanism.

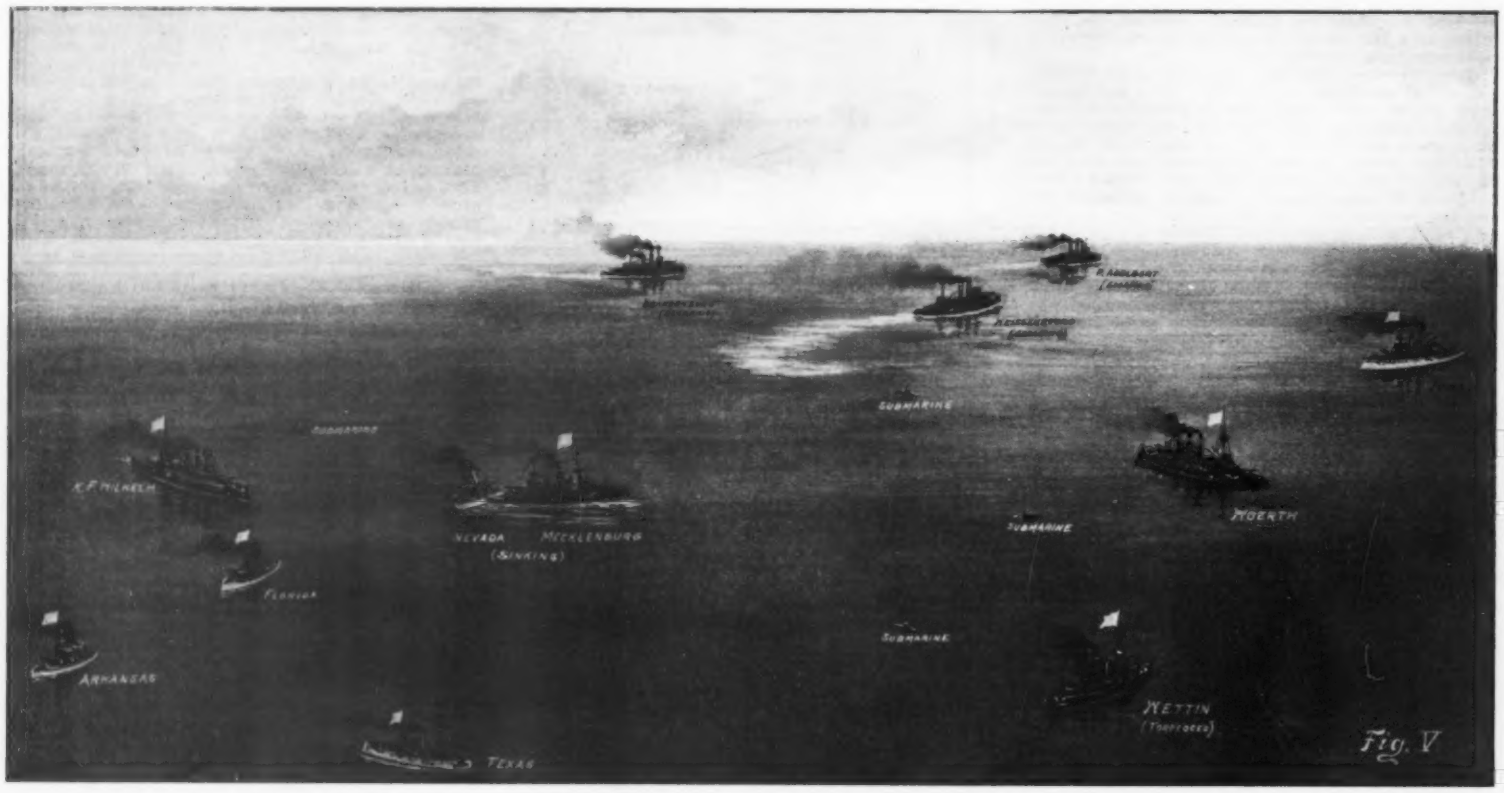


Fig. V

LAST BATTLE OF THE GERMAN-AMERICAN WAR. FINAL STAGE. SUBMARINES TURN THE DAY BY SINKING THE GERMAN BATTLESHIPS.

LANTERN SLIDES.*

By J. P. ZENNER.

So much has been said and written, and so well said and written, and printed on this subject, that it seems almost impossible to say anything more to the point without repeating what has already been said, and, perhaps, much better than I could say it. Therefore, I have deemed it just as well to recall and repeat some of these sayings, and have culled from some of the articles that came within my reach some of their good points and have combined the same in this paper, with such other hints and suggestions which appeared to me to be pertinent to the subject at this time.

Slide making originated in the United States, having been invented, as is claimed, by one Langheim, of Philadelphia, some fifty odd years ago. It at once became popular, and continued to fascinate not only those directly interested in the production of slides, but old and young who simply wished to see pictures in an agreeable way.

Thanks to the efforts of the plate makers, and the ready-to-use developers, and other materials and solutions on sale at the stock houses, nothing in photography is easier than to take the ordinary black and white commercial slides, for the maker quickly learns how to expose almost as fast as he can put plates into the holder or printing frame. After a dozen or two of the plates have been exposed, they are all placed in a large tray, flooded with developer and, after a minute or two, transferred to the hypo bath, in all stages of under and over development.

This is not overdrawn, and is practically the manner in which most professional slides are made . . . . The making of a good slide begins with the making of the negative, the operations in both cases being closely allied, and he who has mastered the first, which is the corner stone to all successful results in any branch of photography, may well be expected to be able to make a good lantern slide. A slide is judged not by what it appears to be when held in the hand, but by its appearance when magnified two to five thousand times on the screen, where a small defect in the slide will show up as a gross fault. Patience and cleanliness are absolutely necessary. The greatest caution should be observed to keep the lantern plates free from dust, both before and after exposure and development, for small pin holes and dust spots, hardly noticeable on the slide, assume huge proportions on the screen and detract materially from its beauty.

The high lights in a slide should, in rare cases only, be represented by clear glass, and the shadows should always be transparent, even in the deepest part. The balance between these extremes should be a delicate gradation of tone from the one to the other. The contrast between the strongest high light and the deepest shadow should be enough to give brilliancy without hardness and delicacy or softness without being flat. This is controlled also, to some extent, by the subject, summer sunshine requiring a more vigorous rendering than hazy autumn effects, and herein each individual must decide for himself what is most necessary to give the correct portrayal of the subject. It is a good idea to procure a slide, as near technically perfect as possible, from some slide-making friend, or dealer, and use it as a standard to judge your work by, and to make slide after slide from the same negative until a satisfactory result is reached.

I am not prepared to recommend any special make of plates, believing them all to be as good as claimed by the various makers, and knowing that successful slides, as well as horrid failures, can be made with any of them. Neither do I care to go into the chemical part of the work, or advise any special developer or formulæ, but would suggest that the developers and formulæ given with the plates you suggest be studied, and such of them used as appeal to your special favor and the nature of the subjects. A black tone of good quality is usually satisfactory for most slides, but to the eyes of the audience it is very agreeable to see interspersed a variety of tone, and beautiful slides can be made, where the subject warrants, in blue, brown, purple and even red and green, by varying the exposure and development and by using gold or uranium toning baths and other solutions for that purpose, the formulæ and materials for which are easily obtainable from the magazines and from stock dealers, respectively.

It must be understood, however, that these toning solutions generally act as intensifiers, and that if toning is contemplated, it should be borne in mind at the time of developing the slide, so that it may not finally appear too dense. Toning will improve otherwise weak slides, but will not help under-exposed ones, as its tendency will be in such case to increase the contrast, which in such slides is already too great. Another method of getting a fine quality of slides is to make rather strong exposures and to develop deep, or much too far, and then to reduce with persulphate of ammonium. This method has been followed by some of the best workers in this field, and the particulars have been published in the various magazines and can easily be obtained.

The popular methods of making the exposure are: first, by contact in the printing frame, just as prints are made on Velox or other developing paper, provided the subject on the negative is of the right size for a lantern slide; and the other and better method, which I recommend to all who are in earnest about the making of satisfactory slides, is the camera method, by which the subject of any negative, large or small, or any part thereof, can be reduced or enlarged, and thus brought to the proper size desired for the slide, which, by the way, is quite a knack, and should be considered and studied by the slide maker very carefully. By this I mean to say that the full opening of a commercial mat of two and three-fourths by three inches is not suitable for any and all subjects, as it is sometimes seen at an exhibition of commercial slides, where the full area of the screen is utilized irrespective of whether the subject is a portrait of a baby or a perspective view of a ten story building.

Hard and inflexible rules cannot be laid down in this relation, but I find that portrait studies of bust or three-fourths figures, or baby figures, need not be made for a larger opening than one and one-half by two inches, and often appear to good advantage if made quite a bit smaller, but figure or group compositions with considerable background or accessories may, of course, have a larger opening to suit the particular circumstances. Monuments, tall buildings and subjects of that description should have the benefit of the whole height of mat opening of two and three-fourths inches, and should be made of a size to properly fill it out, providing, however, for sufficient foreground and a proper sky line. Landscapes and marine views generally can be made to fill out the full length of mat opening, which, however, should not exceed two and seven-eighths inches, and may be of any height to suit the subject, up to two and three-fourths inches.

The subject should be well centered on the plate and the part intended to be shown as the picture should be well within the size of the mat opening decided upon, so that with a slight variation of the placing of the mat no part of the picture will be cut off by the carrier in the stereopticon. The horizon line in a landscape, and more particularly in a marine view, should always be in proper position, either below or above the center line of the slide, as may suit the subject, but should never divide the picture in the middle and should not appear to be running either up or down hill. And the vertical lines in the pictures should not be leaning, but should run parallel with the side lines of the mat; this refers especially to the vertical lines in architecture, excepting, however, the tower of Pisa and kindred subjects, which should in every case be shown with their natural inclinations.

As to time of exposure, very little can be said, as that varies with the different makes of plates, with the quality of the light and the nature and density of each individual negative. Therefore every one must be a judge unto himself and make as good a guess as he can for the first trial from each negative and gage further exposures from the results thus obtained; but this much I will say, that a negative, strong in contrast should be given a long exposure, close to the light, if artificial light is used, or in strong daylight, and developed with a weak or very much diluted de-

* Read before the Buffalo (N. Y.) Camera Club and printed in the Professional and Amateur Photographer.

veloper to make a soft slide with full tone values. And a flat, weak negative will yield better results if exposed farther from the light or to a weaker light, and developed by a normal or more aggressive developer. Over exposure and under exposure show the same results in slide plates as in negative plates and the treatment should be similar in both kinds of plates except that, perhaps, in cases of under exposure of slide plates, the better plan would be to cast them aside and make them over, as very little can be done with them. And for getting bright and clear effects it is now well understood that better and more satisfactory results are obtained by backing the slide plates, as well as by backing negative plates. This is accomplished by coating the back or glass side of the plate with the following mixture:

Gum arabic	½ ounce
Caramel	1 ounce
Burnt sienna	2 ounces
Alcohol	2 ounces

Mix and apply with small sponge or wad of absorbent cotton.

It should coat thin and smooth and dry hard enough so it will not rub off when handled. If the plates are put into a light-proof grooved box as fast as backed, they can be used about half an hour after being coated. And before developing, this backing should be removed; this is best done by first wetting the film side of the plate under the tap, which will prevent staining it, and then letting the water run on the backing, and, with a little rubbing, it will disappear in a few moments, when development may proceed. Other preparations for this purpose, ready for use, may be found at the stock houses.

I would again call attention to the necessity for the utmost care and cleanliness at every turn, so that the slide will appear crisp and pure, without scratches, dust-specks, finger-marks or stains of any kind, and that the same care and patience be continued until the slide is mounted and labeled complete; the cover glass should be examined for marks and blisters, and cleaned of all dirt and finger-marks. The mat should be carefully selected, or cut of a size and shape to show up the subject to best advantage, and should cover everything not wanted in the picture. The opening should not exceed two and three-fourths by two and seven-eighths inches in any case, and must not be ragged or fuzzy, but clean cut and symmetrical. The lines of the opening of square mats should be parallel with the outside lines of the plate. Oval, or round, or other variously shaped mats, should be used sparingly, and in special cases only where the nature of the subject will warrant their use.

Statuary shows up to best advantage when the background is blocked out. This is easily done with a small camel's hair artist's brush and opaque or india ink, in a retouching frame, a good eye and a steady hand being the only additional requirements. This treatment may also be applied to some flower studies and other botanical subjects.

When the slide is ready for the binding this process may be performed with the aid of a stationer's spring clamp, such as are used for holding papers together, and can be purchased for ten cents. Cut your binding strips the length of the sides and ends of the slide, and gum them on separately, rubbing them firmly in contact with the glass with a piece of cloth or an old handkerchief, which might be kept handy for that purpose, so that the binding may not loosen or peel off after the slides are handled but half a dozen times. And then before storing the slides away for future use they should be properly labeled and named. The name label should be affixed on the right end of the face of the slide as you look at it in its proper position, and should contain the maker's name and the title of the slide. The thumb label should be affixed to the lower left hand corner of the face of the slide, and may show the number of the slide.

The title to a slide is quite an important matter, and should be pertinent to the subject. If it be a landscape, and no proper or descriptive name be known, it should, nevertheless, not be called simply a "landscape," but some expressive title or suggestive quotation should be found for it. This may, at times, be not so easy as it might appear, but with a little study it can be accomplished. Likewise a portrait should not be simply dubbed a "portrait study," but an appropriate name should be given. This also applies, in like manner, to all other subjects, such as flower studies, fruit pieces, or any other subject, for any of which, if a proper name does not apply, or if a diversity exists, some appropriate quotation or suggestive sentiment can be found which will greatly enhance the interest in the slide. . . .

AND finally, I wish to say that success is not reached unless one thoroughly believes that what he is doing is worthy of his best energies; what is required is steady, open-eyed perseverance and cultivation, not merely of one's artistic and technical vision, but a perpetual post-graduate course in accurate reasoning. You will get from your work that which you give it; but one can give a great deal, and if you make yourself believe that in it no art is possible, you will certainly never find any, and vice versa. To succeed, you must read intelligently, study carefully, believe it is worth while to give your best attention to the work, and then translate your study into practice, watching critically every step as you go. No sudden flights of inspiration will carry you very far, although inspiration is needed sometimes to keep up one's courage. I wish to urge at the same time the danger of being satisfied with your work, for it is fatal to progress. Your satisfaction will be like that of the five little green peas in Hans Christian Andersen's fable, whose own tiny pod was all the world to them.

Profiting by the unfortunate fall of the Campanile, which might have been saved had timely precautions been taken, the Academic Council of Venice have decided to adopt the recommendations proposed by Signor Monfredi, the architect to the council, to preserve and repair the other historic buildings in the city, and work will be commenced immediately. The first building to be taken in hand is the Procuratie Vecchie, which, although in no imminent danger, it is intended to take steps at once to place the palace out of all peril for the future. To complete the repairs of the Doge's Palace it will probably be necessary to place beams across the canal over which the Bridge of Sighs is built, to support a portion of the leaning wall fronting on the canal.

COLOR PHOTOGRAPHY.*

By SIR WILLIAM J. HERSCHEL.

THE attempt to reproduce the natural colors of objects in a picture of them by means of photography may be regarded, according to a man's fancy, either as a confession of weakness—of lack of artistic power in one's self—or as a laudable ambition to invoke the powers of nature to do what, with all human skill, no artist can ever expect to do or ever claims to do. The artist, whether of the pencil or of the palette, has a liberty of expression which must forever make him master of the spirits of men when they seek the aid of painting or drawing to represent any scene to their senses. He alone understands the spirit that seeks his aid. He alone knows how to minister to it in the way that will most delight and instruct it. God has given him a great wealth of materials and the incomparable gift of genius in his use of them to interpret a scene to his fellowman. If he fails, as he often does, in his task, that is no more than human frailty involves. When he succeeds he has given us a joy which we never dream of attaining in any other way short of once more beholding the object of our desires as we saw it in some happy moment of our lives. I am speaking, of course, only of realities and not of poetical or ideal art.

No one can be more conscious of the vast interval that lies between himself and the true artist than the humble follower of nature along the paths of color photography. To describe his position as a student fully and justly would occupy more time than you can spare me; but of this I am confident, that no artist can have his feelings more keenly cultivated, his appreciation of the delicacies of hue and of shading more exalted, or his ambition to equal nature more excited by the first fruits of his labors than the patient, watchful handler of the camera and its adjuncts. The artist, indeed, stands at a strange disadvantage here. No joy can ever reach him which he has not, in the richness of his imagination, already tasted before he meets it face to face on his canvas. But who that has hung in eager expectation over the growing wonders of the sensitive plate would exchange his happiness when success rewards him for that of the artist over his own handiwork; surprise, gratitude, exhilaration, these are the sudden moods of the photographer who throws himself into the arms of nature and trusts to her methods while incessantly pleading for more and more of her instruction. What shall I say of his many, many disappointments? Let them pass. We know their value, and the artist knows this, too. Our joys and his are not the same, but both are ripples of that *ἀνηρίθμον γελασμα*, the countless laughter of the ocean on which God's great gift of light dances and entrances us.

So it is in the most perfect humility of spirit that we approach the subject of our discourse this evening—the practical methods now known to us of producing colored photographs.

These fall into two groups. In the first, as now in our common possession and practice, come those which employ colored glasses or films to feed the photographic plate, leaving the latter to take what it will, or refuse what it will, according to the high commands impressed upon it by the sun. Let no one be under the delusion that here is any room for the color artist, man, to tamper with the result, to distribute the colors according to his fancy. The very contrary is the case. No department of photography is so hopelessly bound to perfect honesty and freedom from trickery as color photography. A first-year apprentice in the studio of Mr. Herkomer would as soon think of improving the master's touches. It would mean ruin to the picture. Whatever color is supplied is fairly offered to the sun at every pin's head of the plate alike; but whether it is to be seen at all, and if seen whether it is to be seen in its full strength or weakened to any necessary extent, is not in our hands. That rests with the light itself to determine which falls there on the sensitive surface, and woe to the man who tries to interfere there. He may use some influence in regard to considerable areas at a time, just as the ordinary photographer can shade or modify the light to produce general effects, but as to details he dare not say a word. He might as well try to improve a miniature with a house painter's brush.

The first specimens of this kind which I introduce are those of Mr. Ives's process.

The three photographic positives here thrown on the screen together as one picture are plain black and white. They each act in the same way that the natural object did—they do not, indeed, absorb the color of the coloring glass; but they do what comes to the same thing, they block it out either totally or in various degrees as each point of the object did by absorption. The positive was obtained by photographing the object through a glass of somewhat similar color. That it is not the very same color is due to the fact that the photographic power of colored light is not on all fours with its coloring power upon the retina.

To go into anything like detail on this complex and still debated part of the science of color photography would be quite impossible—and I am glad for your sakes that it is so, for only a strong expert like Mr. Ives or Mr. Sanger Shepherd could lead you aright there. Suffice it to say that at this point the judgment of the human eye is the final court of appeal, and no conclusions based upon anything less than large practical experience can be deemed final. We are still in the purely empirical stage of knowledge as to the physical connection between the color and the actinic power of any given light. We are not even sure that a given color of a given intensity has a constant actinic power on a given film. What we see here is the result of Mr. Ives's immense practical study.

His Kromskop introduces the three colors to the eye, not by superposition, which, as you will readily see, would put three extinguishers on the top of each other, but still by true *com*-position. The mirrors (sheets of transparent glass) which do this are models of inventive power. They are not clear glass, but tinted, and the reason for this is a matter of refined delicacy. The already green image passes through a transparent green glass, placed on a slope which thus serves on its front face as a mirror for the blue image. The latter would be reflected from the back surface also if the glass were clear white; but being green, it absorbs the second reflection sufficiently (in the double passage of the blue light) to make it innocuous. The composite blue-green image passes on to the eye through another sloping transparent mirror placed to reflect the red image in the same line of sight. The same danger of a double red image is avoided here by tinting the mirror blue-green, which lets the blue-green image pass, but kills the red light which endeavors to get twice through it. The perfection of the register is thus preserved.

Of a cognate character, but very different in its method, is Mr. Sanger Shepherd's process, in which three differently colored films are *super*posed one on the other in a single transparency. They are all positives without any opaque silver deposit to block out light. The only gradation is from clear white to the deepest color of the dye on each film—superposed they act as absorbents, and so effect the same fallibly, as far as I am aware; but, assuming it to be true, see what it means; nothing less than this, that we have, by the infinite delicacy of photography, obtained a definite ocular demonstration of the precise seat of power which ether waves have over chemical compounds. If I hesitate in committing my own belief to this explanation (and my belief is a matter of absolutely no importance to anyone else) it is because it is not inconceivable that the disruptive action which does take place may, after all, occur close round the spot where the stationary ether of the node, and therefore the matter which is affected, is under alternate tension and relaxation. However that may be in physics, the difference is not of immediate importance to us in photography that I see. The actinic planes were proved by Wiener to exist. Lippmann turned them to vital account for us, and gave us, in the way we all know, true color photography. He used thick films for the express purpose of securing what Wiener desired to avoid, reduplication of the actinic planes, and with them the strong creation of color. Here are some of the most exquisite results of his process. I owe them to Dr. Neuhauss, who kindly supplied me with a spectrum and a vivid picture from what I may call still life, and to Mr. Senior, who has placed his best specimens of a spectrum with the Fraunhofer lines at my disposal for your service. A more precious one than any of these is this given me by Dr. Lippmann himself, a tribute to my father's memory as a pioneer of photography, which I shall be happy to show afterward. It is the simple naked film itself.

Before parting with Lippmann's process I feel sure that you will like to see the decisive evidence obtained by Dr. Neuhauss of the presence in the film of the supposed strata of silver spangles, as I may call what looks like a brown stain more than anything else, by transmitted light. He has actually made a microscopic section of the color cradle, and by means of the most refined conditions has been able to take once more by aid of photography a visible picture of the subtle work of light in the interior of a Lippmann film. Here is a copy of it on the screen which he has sent me himself, with his explanation of its import and its manufacture. All room for doubt (if science could cease from doubting its own creeds) would seem removed by this simple fibrous-looking strip of lines. It is a rare pleasure to be able to exhibit such brilliant colors, and such surprising demonstrations of their cause, here in Oxford, and to acknowledge at the same time that the whole series of investigation and invention which have furnished these magnificent results is the fruit of French and German industry and genius.

* Presidential address by Sir William J. Herschel, Bart., to the sixteenth annual meeting of the photographic convention of the United Kingdom, Oxford, July 8, 1901. Reprinted from the British Journal of Photography.

AIR-BORNE SMALLPOX.

A VERY important report, by Dr. G. S. Buchanan, on an epidemic of smallpox in the Union of Orsett in 1901-2, has just been issued by the Local Government Board, and contains a large amount of evidence in support of the opinion which was originally advanced by Mr. Power, F.R.S., now Chief Medical Officer of the Board, to the effect that smallpox hospitals may become sources of serious danger to the unprotected populations in their vicinity. The smallpox ships of the Metropolitan Asylums Board are moored in Long Reach, close to the Kent shore; and on the south side they have only the uninhabited Dartford marshes within a mile of them. Between them and Essex is the river, here about half a mile across; and on the Essex shore, at a distance of from half a mile to a mile, is the village of Purfleet, which (excluding the garrison) has a population of 600. By far the most striking feature of the Orsett epidemic was the sustained incidence of the disease on Purfleet, and on West Thurrock, which adjoins Purfleet. To take Purfleet alone, out of its 600 inhabitants, no fewer than fifty-three suffered from smallpox. The relationship of these occurrences to the smallpox ships can hardly be doubted; nor can it be questioned that, as there is no personal communication or traffic of any kind between these ships and the Essex shore, the infection, if conveyed from the ships at all, can only have been conveyed in the manner which Mr. Power pointed out, that is to say, through the medium of the air. The Metropolitan Asylums Board has decided to discontinue the use of the ships at the earliest possible opportunity, and in place of them to utilize the hospital now being built at Joyce Green, which has still fewer inhabitants within the distance of a mile. Moreover, as Dr. Buchanan points out, the recent epidemic has itself rendered the future position more secure. A smallpox establishment at Long Reach might now continue to be used without entailing much danger upon Essex, for the sufficient reason that hardly any one remains in

Purfleet who is at all likely to contract the disease for many years to come. It is unnecessary to say that the whole difficulty would vanish if we could secure the general population near the hospitals was protected by vaccination and revaccination. A striking proof of this is given in Dr. Buchanan's report. Notwithstanding all the smallpox in Purfleet, and notwithstanding proximity to the hospital ships, not a single case occurred at any time among some 215 persons belonging to the Purfleet garrison, or among 266 inhabitants of the training ship "Cornwall," which is moored less than half a mile from the hospital ships. Both communities at the outset of the epidemic, were already protected by systematic vaccination and revaccination.—London Times.

THE ELECTROLYTIC RECOVERY OF TIN FROM SCRAP AND CUTTINGS.

RECENT issues of the Zeitschrift für Elektrochemie contain a lengthy memoir by Dr. H. Mennicke upon this industry. According to the author 30,000 tons of tin scrap are treated annually by the electrolytic processes in Germany alone, and tin scrap of good quality is now difficult to obtain in that country. Works are reported to be in operation at Essen, Kempen, Uerdingen, Nuremberg, Ludwigshafen, Emmerich, and Flushing (Holland), the largest of these being that located at Essen. A new works of this character has recently been erected at Pfaffstatten, near Vienna. The cuttings and scrap are drawn chiefly from England, France, and Switzerland, and the average value of the scrap does not exceed 3.5 per cent of tin. The author treats his subject in a most exhaustive manner, and discusses various practical details of the technical process under ten sectional headings. He is of opinion that the alkaline process yields the best results, as the metallic (tin and iron) residues obtained from the sodium stannate solutions are best adapted for the further smelting operations required to yield the tin and iron in commercial form. The addition of sodium chloride to the alkaline electrolyte he regards as unwise, since it leads to the increase of impurities in the final products of the electrolysis. The maximum recovery of tin possible by the alkaline process, according to the author, is 88 per cent, and recovery of the remaining 12 per cent present in the scrap is only possible at the cost of the electrical and economic efficiency of the process. The author estimates that a works for the treatment of 9,000 tons of tin scrap yearly by the alkaline process would require 60 cells of about 3 cubic meters capacity, each cell containing, when fully charged, three baskets of cuttings, or 150 kg. scrap. The author has carried out a large number of experiments relating to the conditions necessary for obtaining the best results from the alkaline process, and the results of these are given in the original paper, which is well worth the study of all interested in the subject.

THE OSMIUM ELECTRIC LAMP.

THE interest which has been manifested, both in incandescent gas-lighting and electric-lighting circles, as to the commercial possibilities of the osmium electric lamp, devised by Dr. Auer von Welsbach, will be somewhat deepened by a noteworthy article which has just been published by a leading Berlin newspaper. It has been claimed that the osmium lamp will effect a revolution in electric lighting in the sense that it will render for this industry similarly advantageous services to those afforded to the gas-lighting branch by the Welsbach incandescent burner system, and it is believed that when the former is placed on the English market it will be controlled by the British owners of the Welsbach incandescent gas-lighting patents. So far, however, the osmium lamp has not arrived, and the reasons as given by the Berlin Tageblatt are not without interest at the present moment.

It appears that at one time the shares of the German Incandescent Gas Light Co.—the Welsbach enterprise of the Fatherland, and the purchaser of the patent rights of the osmium lamp for Germany, Luxemburg and Holland—advanced to the almost unprecedented premium of 1,000 per cent, and that, apart from the heavy declines which have since occurred simultaneously with the drop in the very high dividends which were paid, a further fall to the extent of 50 per cent took place during the month of September. The Berlin newspaper attributes this unfavorable circumstance partly to the fact that, in consequence of increasing competition, the company no longer plays the same important rôle as in former years, but mainly to the uncertainty surrounding the fate of the osmium lamp, upon which exceedingly sanguine expectations have been based. In support of the latter statement, the article refers to the company's report for 1900-1901 wherein it is stated that it is hoped so to increase the manufacture of the lamp in the winter season as to yield profits in the new year, and that from the measurements and experiments made, the lamp would constitute a lucrative invention in the future. As recently as July last the company repeated the assertion that the lamp would be placed on the market in the coming season, and a few days ago it was stated by the company that the prices and conditions of sale have not yet been fixed, so that there is no information as to when the lamp will be brought out for commercial purposes in Germany, much less in England.

It appears, however, that notwithstanding the relatively small consumption of electric current, the construction of the osmium lamp is far more difficult than that of an ordinary incandescent electric lamp with a carbon filament owing to the metal osmium, apart from its comparative scarcity, being difficult of treatment, so as to obtain an equality of the metal forming the lamp filament. In fact, the principal obstacle is said to lie in the impossibility of constructing lamps having a sufficiently high electrical resistance, as the osmium wire is either so long or so thin that at white heat—that is, when at the incandescent stage incidental to ordinary use—it is unable to retain its original shape. It remains to be seen whether this difficulty can be surmounted, although the company claims to have done so now. The German company, which several years ago paid dividends up to as high as 130 per cent, and as much as 28 per cent a year ago, announces that the financial year now closed will show a further decline in the amount of the distribution.

REMARKABLE PICTURES OF AN ELECTRIC ILLUMINATION.*

By ARTHUR INKERSLEY.

EVERY year the Knights of Pythias hold a convention in some city of the United States. The annual convention of 1902 was held in the city of San Francisco,

ELECTRIC ILLUMINATION IN SAN FRANCISCO.

Cal. During the ten nights of the visitors' stay, Market Street, the principal thoroughfare, was brilliantly illuminated with electric lights. At the intersection of Geary, Kearny, and Third Streets with Market Street a "Court of Honor" was erected. This consisted of rows of white pillars, from which strings of electric lights ran up to a large circle suspended over the point of intersection of the streets. The scene was dazzling, and the view, as one looked up or down the street, quite striking. The remarkable picture reproduced from a photograph taken by P. F. Dana, of San Francisco, shows the festoons of electric lights and the central platform to which they were all united as viewed by a camera placed directly underneath. The other view shows the upper side of the disk from which the festoons of electric lights were strung, with workmen upon it.

THE DISK FROM WHICH THE ELECTRIC LIGHTS WERE SUSPENDED.

To Strengthen Pack Threads.—An extraordinarily strong pack thread or cord, says the Pharmaceutische Centralhalle, may be obtained by immersing the thread in a strong solution of alum, and then carefully drying it.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

CONTEMPORARY ELECTRICAL SCIENCE.*

MAGNETIC RESISTANCE OF A STRETCHED BAR.—M. Fraichet describes the following experiment upon an iron bar. The bar is made the core of an induction coil in which the primary coil is traversed by a continuous current. The terminals of the secondary coils are connected with a galvanometer, and the bar is stretched. The fibers of the iron are not all identical, and, therefore, they break one after the other. The galvanometer shows a series of jerks as soon as the elastic limit is surpassed, each jerk meaning the rupture of a fiber, and indicating the size of the fiber by the extent of the swing. The flux through the fiber falls suddenly at its rupture, and then increases again as the rupture is cemented by non-fibrous iron entering the crevice. The number and amplitude of the oscillations increase the more fibrous the metal is. A bar of hard-tempered steel possesses no fiber, and, therefore, the flux traversing it varies continuously until the metal is ruptured. The same is the case in any bar which has already been stretched beyond the elastic limit. The latter can be variously defined. It is either the elastic limit of the cement or non-fibrous matter, or the elastic limit of the weakest of the fibers, indicated by the first oscillation of the galvanometer. Both these limits are usually close together, and close to the apparent elastic limit indicated by the testing machine. But some specimens of puddled iron show jerks as soon as loading commences.—Fraichet, Comptes Rendus, October 27, 1902.

MAGNETIC DEFLECTION OF PLUMB LINES.—Plumb lines should not be made of iron, as they are deflected by the earth's field. Such is the opinion of W. Hallock, as a result of observations in the Tamarack mine, on Lake Superior. In this mine it became necessary to plumb down two points to a depth of 4,250 feet, and for this purpose the plumb lines were made of No. 24 piano wire, carrying a 50-pound iron weight. The points were 17.58 feet apart on the surface, but it was thought that they might show the convergence of the earth's radii, or possibly the Newtonian attraction between the two 50-pound masses of iron. On measuring the distance apart at the bottom it was found that, on the contrary, they were 0.07 foot further apart at the bottom than at the top. This could not be explained as due to an attraction of neighboring matter, since the effect of the latter would not exceed a displacement of 0.001 foot. W. Hallock has studied the effect. He found that when two plumb lines 75 feet long, one of iron and the other of copper, were suspended side by side in the magnetic meridian, the bobs were about 1-75th inch closer together when the iron was south of the copper than when it was north. Hence copper or phosphor bronze wires should be used as plumb lines where accuracy is required. F. W. McNair points out at the same time that the true explanation of the Tamarack mine result was not a magnetic one. It was eventually shown to be altogether due to air currents in the shafts.—W. Hallock and F. W. McNair, Terrestrial Magnetism, September, 1902.

ELECTRIC EPILATION.—According to T. Guilloz, the electrolytic method of removing hairs is both the slowest and surest. The active negative electrode is a fine needle of platinum, gold, or, better still, steel, which is introduced along the hair down to the bottom of the bulb. A current of 1 or 2 milliamperes is passed for a time varying from 20 to 50 seconds, and that gives an effective galvanocautery. The intensity of the current can be increased if the patient can bear it, and the time of operation diminished proportionally. The hydrogen disengaged round the needle in the shape of a slight whitish foam forms a guide as to the progress of the electrolysis, and when it is finished the hair comes out without any effort, taking with it a number of inflated clear cells surrounding it like a sheath. Hayes, Brocq, Debédat and other authors have described with great care the technical details of this operation. According to Giovannini the cells of the epithelium and the endothelium are specially sensitive to the action of the current, whereas the epidermis and cornea resist better, so that the destructive action of the current always acts upon the bulbs of the hairs although the needle may not touch them exactly.—T. Guilloz, Arch. d'Electr. Méd., October 15, 1902.

* Compiled by E. E. Fournier d'Albe in the Electrician.

MONORAIL LINES.

A PROJECT was submitted to the British Parliament last year, for the building of a railway from Liverpool to Manchester. The trains were to run at the unprecedented rate of 100 miles per hour, the track being built on the Lartigue system, that is to say, with a single central rail. This system has the great advantage of rendering it almost impossible for the train to leave the track and cause those disasters which occur from time to time with our usual system. For the single rail passes right through the center of the cars, which ride upon it, and inclose it on both rides. Strictly speaking the word monorail is a misnomer, for, though it is true that the train is supported almost entirely by a single rail, the two guide rails, which are always provided are absolutely essential for balancing the cars. Without them the position of each car would vary according to the arrangement of its load, and the train would be thrown into violent oscillation.

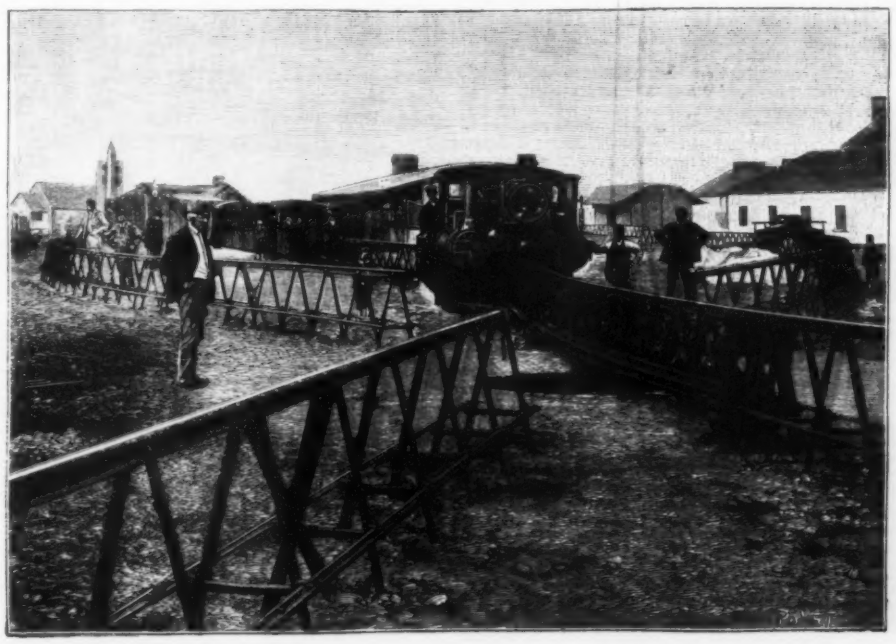
This monorail proposition was, however, rejected on account of certain details in the construction, but it is now again under consideration, and it seems likely that before long the line will be established, and travelers will be able to reach Liverpool from Manchester (30 miles) in twenty minutes.

This question lends a peculiar interest to a little railway on the west coast of Ireland, which was opened in 1887. The track, which has a central single rail, was built by the Lartigue Railway Construction Company, and is 9 miles long. It connects the important town of Listowel with the delightful seaside resort of Ballybunnion.

The central rail, which weighs 8½ pounds per foot, is fixed upon a series of A-shaped supports spaced 3 feet, 4 inches apart, and anchored by transverse horizontal sleepers.

The two auxiliary rails are also fixed upon these supports, parallel to the main rail, but some distance outward from it and 2 feet, 6 inches below it. It is obvious that the usual switches can not be worked on such a system of rails. The switching is effected by means of revolving platforms constructed on the ordinary plan. One of these is shown among other things in our illustration.

The rolling stock also must be adapted to these special conditions. Thus, for instance, the locomotives are built up of two similar engines joined laterally, each having a distinct boiler, firebox, and funnel. But the two boilers intercommunicate, so as to equalize the pressure and the level of the water. These twin engines are supported on three wheels 2 feet, 6 inches in diameter which fit upon the central rail. One of these—the middle one—is the drive wheel. Four other wheels of 10 inches diameter are fixed two on each side and rest laterally against the guide rails. Their axes are vertical, they do not serve in any way for propulsion, and the friction in them is very slight. The double tender will contain about half a ton of coal and 250 gallons of water. It also runs on three central wheels of 2 feet, 6 inches diameter, and is held in position by running wheels, just like the locomotive. The cars are of two types, according as they serve for carrying passengers or merchandise. Like the locomotive and the tender they are composed of two twin portions. The passenger cars are 20 feet long, 7 feet, 7 inches high, and 10 feet wide. They accommodate twenty-four passengers, twelve on each side. A communication is established between the two halves of the car by means of steps. These cars run on four wheels of 1 foot, 8 inches diameter, placed two at each end of the car and running on the central rail. This enables the train to turn very sharp curves.



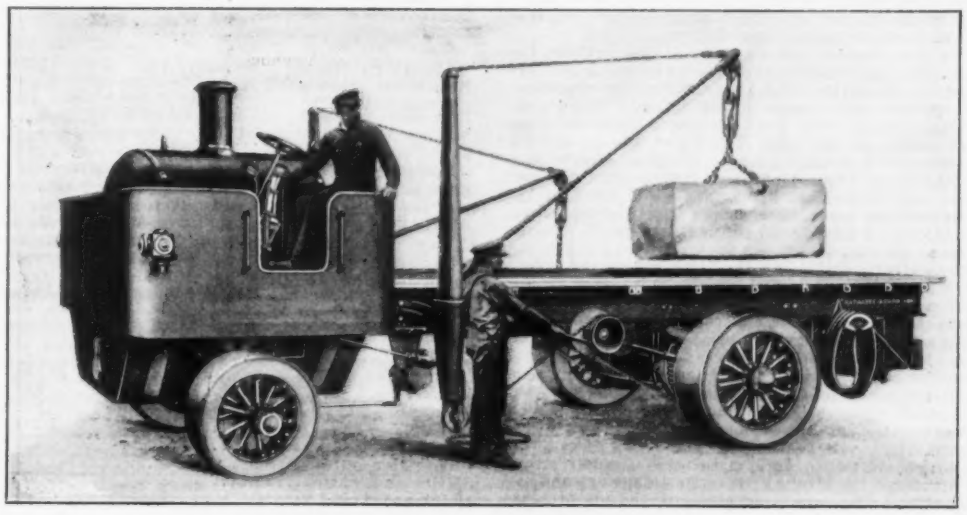
MONO-RAILWAY BETWEEN LISTOWEL AND BALLYBUNNION, IRELAND.

For level crossings it was found necessary to build drawbridges, which normally close over the central rail, but which can be withdrawn at the time when a train passes. Signals placed at intervals of three hundred feet along the line, enable the engine driver to tell whether these drawbridges are down or whether the track is free. The speed on this line is only 18 miles an hour, but the engines are capable of pulling a train of 240 tons at a rate of 27 miles per hour. The cost of installation of this line, including price of land and rolling stock, was only $15,000, and the little railway has done excellent service since it was opened.

At the international exhibition of Brussels in 1897 Mr. Behr, the director of the Lartigue Railway Construction Company, constructed a model line of the same kind, which operated perfectly. Its length was 2¾ miles, and the speed attained, 66 miles per hour. This success encouraged Mr. Behr to form the project for the mono-railway between Manchester and Liverpool.

The system appears to be thoroughly adapted for quick traffic. High speed is the goal toward which all traveling tends, and the use of the monorail will often be the means of attaining it. To the little railway between Ballybunnion and Listowel will belong the honor of having been the pioneer of the system.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

The boiler is of the water-tube type, the design being something like that used aboard torpedo boats. The steam drum and the two mud drums are of extra heavy steel tube, and have at each end large handholes, so that the entire boiler may be easily cleaned. These drums are connected by 1-inch seamless, drawn steel tubing, the joints being of a special design, which makes replacement of tubes an easy matter. In case a tube gives out, and there are none on hand for repairs, each opening may be effectually closed by the insertion of a flanged plug. There is a dome above the steam drum, which thoroughly dries the steam before it is taken to the engine. The whole is incased in a double steel jacket, with a 1-inch lining of fire felt next to the flame, and a 1-inch, porous, asbestos lining between the shells. As a point of convenience, it should be noted that by breaking the steam and water connections and removing four bolts, the entire boiler may be lifted bodily from the truck. The outer shell also is arranged with the idea of making access to the boiler as easy as possible. The boilers are given a cold water test of 600 pounds, and also a steam test



THE LARGEST STEAM TRUCK IN AMERICA.

STEAM TRUCKS FOR HEAVY HAULING.

BUT few steam trucks for heavy work have been built in this country, most of the vehicles of this type having been designed and constructed in England. Probably the largest automobile truck ever built in America is that illustrated above, which is one of the productions of the Morgan Steam Truck Company, of Worcester, Mass.

The general dimensions of the Morgan ten-ton truck are as follows: Total length, 22 feet, 5 inches; total width, 7 feet. The loading space is 16 feet, 10 inches; and the truck has a total loading area of 118 square feet.

What may be called the foundation of the truck is formed by two 9-inch I-beams. These are tied together with 3-inch I-beams for that part of the frame which carries the loading platform, by two 3-inch channels in front of and 7-inch I-beams behind the boiler, and also by the boiler suspension, and two 6-inch deck beams over the rear axle. The framework is of a design sufficiently heavy to withstand the strains to which it may be subjected.

of 300 pounds. The safety valve, which is a locomotive muffled pop, is set at 225 pounds. The working pressure is 180 pounds. Water is supplied to the boiler by a power pump geared to the engine, the amount being regulated by the usual bypass.

Either gasoline or kerosene may be used for generating the steam. The burners, of which there are two, are easy of access, and may be drawn out together by the disconnecting of a single joint. They may be reached either from the front or from the rear. The oil is not carried under pressure in the tanks, but is forced into the burners by a small pump which is geared to the machine.

The engine is a double, tandem, compound, with the cranks set at 90 deg. This type is superior to that of the cross-compound engine ordinarily used on such machines, particularly in that it is at all times possible to start the truck from a stand and without reversing. The crank shaft and the main gear are formed of a single, solid piece of steel. The working parts are inclosed in an oil-tight case from which the cylinders are separated by an intermediate frame. This renders it easy to change the piston and valve rod packings, and also prevents the steam from passing from the cylinders to the crank case and there condensing. By means of a special throttle, it is possible to admit live steam to the low-pressure cylinders, thus nearly doubling the power of the engine. From the engine, the steam passes to a combined feed-water heater and separator. The water of condensation is returned to the water tank, and whatever steam may be left passes into an exhaust head of special design in the space over the boiler, where it is burned up.

The oiling of the various parts of the engine and transmission is taken care of by a small power pump, oil being drawn from the lowest point of the case and carried through small copper tubes to the various bearings. This system of forced lubrication drives a stream of oil constantly about each bearing, preventing hot boxes, and reducing the wear to a minimum.

The transmission gear is also entirely inclosed and runs in a bath of oil. Nothing but spur gears are used throughout the truck. Two ratios of gearing are provided; with one the engine makes ten revolutions to one of the driving wheels, and with the other twenty. The slip gears are on an intermediate shaft between the engine and main sprocket shaft, the compensating gear being on the latter. The engine and transmission gear are in a single case, which is suspended at three points. The cylinder end of the engine is connected to the frame by a pivot joint, and the other two points of suspension are in the ball and socket bearings of the intermediate shaft, which are rivcted to the main I-beams. This method of suspension prevents any strains in the frame from being communicated to the engine or transmission gear. The power is carried from this shaft to the rear axle by two 5-inch x 1½ pitch, silent chains. The large sprockets are bolted to drums or quills. One quill is cast on to the rear axle and the other is a running fit upon it. Each quill carries a 5½-inch hub, over which the rear wheel is slipped and made fast. The outer rims of each of these two quills form brake drums, upon each of which act two shoes, which are controlled by a small steam cylinder. The brake is very powerful and is double acting. Throughout the transmission, the use of keys has been avoided wherever possible.

The entire rear axle construction is especially heavy. It is not in two parts, the quill construction leaving the rear wheels free to act separately. The axle itself revolves in two 5½-inch x 11-inch bearings, which in turn support the rear springs. These, and indeed all the exposed bearings on the truck, are well protected from dirt.

Special care has been given to the design of a wheel, which will withstand the roughest usage. The hubs are very large, and the spokes are of steel. There are two metal tires between which are wood felloes. The rear wheels are fitted with 12-inch steel tires, which give nearly 2 inches of tire surface for every

ton of load carried. The front wheels have 7½-inch tires. The pulling strain of the engine is taken off the rear springs by struts which are braced against the two 9-inch I-beams. The front axle, which is under the center of the boiler, is of 4-inch stock, and supports the main frame on pedestals. Helical springs are here used. The pivot axles are of nickel steel.

The oil tank, which holds eighty gallons, is underneath the body of the truck, just back of the boiler. It is made of 3-16-inch sheet steel. Under ordinary circumstances the tank will hold enough to carry the truck from thirty to forty miles. There is a handhole at the top and an outlet at the bottom, so that the tank can be easily cleaned.

The steel water tank is hung at the rear of the truck. It has a capacity of 250 gallons. There are drains on the bottom, and a manhole at the top, which is large enough to render it easy not only to wash out the tank, but to scrub it with a broom if necessary, or to get inside for painting. The water tank is ordinarily filled by a steam siphon to which is connected a 1½-inch hose. This is always carried with the machine on a convenient bracket. On the front of the water tank is mounted a small, duplex steam pump which may be used to fill the boiler when the engine is standing still.

The driver's seat is on the left-hand of the boiler, there being a seat on the opposite side for a helper. In front of the driver are the water gage glass, which is of the reflex type, and also the valves which control the machine. The throttle is of an entirely new design. It is so made that when the lever is pulled back from the center, steam is admitted to the engine, but when the lever is thrown ahead of the center, the full boiler pressure is admitted to the brake cylinder before mentioned, and the machine is brought almost immediately to a full stop. If for any reason the brakes should fail to work, the engine is amply strong to withstand the strain of reversing under steam.

The valves for admitting steam to the low-pressure cylinders and to the steam pump are close to the main throttle lever. Steam may be shut off from all parts of the machine by a main gate valve placed close to the boiler.

It has been stated earlier in the description that it is possible to back the machine down into an excavation, and bring it out under its own power. Knowing the general character of the ground in such a place, the truth of this statement may have been doubted. The assurance of the possibility of such a feat is, however, not based upon the ability of the truck to pull itself out by tractive power. On each end of the interchangeable shaft there is a capstan. It is possible to throw the engine out of gear with the main transmission, so that it acts only upon the shaft bearing these capstans. Hawse eyes are provided at the front and at the rear of the machine. By tying one end of a rope to a tree or telegraph pole, and bringing it back through the eye to the windlass, it is possible to lift the truck out of any kind of a hole, so long as the tree stays in the ground. These windlasses may also be used in connection with jib cranes, of which there is one of two tons capacity on each side of the machine. By the aid of these cranes it will be possible to load the machine in a very few minutes.

There are two items which affect pre-eminently the cost of trucking; one is the rapidity with which the moving itself may be done, and the other is the time spent in loading and unloading. There is no doubt whatever but that runs may be made much more quickly with a motor vehicle than with a horse, but the matter of loading and unloading is something to which little attention has been given.

With the horse-drawn vehicle the methods of mechanical loading are very few; and in every case which has come to our notice, the loading mechanism is entirely outside of the vehicle, or is found in a hand winch at the front of the truck. When, however, the work of transportation is to be done by a machine, the problem becomes simpler. The two cranes and the capstans have already been mentioned. These will, of course, aid greatly in taking on heavy loads of almost any description where the places of stopping are many. It is possible, however, when regular runs are being made, with two or three regular stopping places, to reduce to a minimum the time that the vehicle must stand still. To accomplish this, a system of interchangeable bodies has been developed, for which a number of broad patents have been granted. The particular system to be installed would depend largely upon the general character of the work. An accurate description of the various systems would take up more space than can here be given; but in general the idea is as follows: Say, for instance, that one of the trucks is to run between two stations: from two to three bodies—and these are very strongly and cheaply built—would be supplied with each truck. At each station slips would be let into the platforms. When the truck backs into one of these slips, the body is left upon the platform in such a way that it is possible for the truck to run out from under it. While this body is being loaded, the truck can back into a second slip and there pick up a loaded body. This dropping and picking up of the bodies would occupy ordinarily but two minutes, as against anywhere from thirty minutes to an hour or more with the old system. These bodies are of a nominal cost as compared with the original cost of the truck, and by employing them it is possible to at least double the efficiency of the truck, and in that way cut in two the cost per ton of carrying material.

COST OF HAULAGE BY HORSES.

Four horses at $200		$800
Team at $500		500
Harnesses at $50 per horse		200
Blankets at $1.50 (two sets)		12
Stable extras (brushes, harness dressing, etc.)		25
Cost		$1,537
Depreciation 10 p. c. per annum of vehicle		50
Depreciation of 25 p. c. per annum of horses		200
Depreciation of 25 p. c. per annum of harnesses	50	
Depreciation of 100 p. c. per annum of blankets	12	
Depreciation of 100 p. c. per annum of brushes, etc.	25	
Total depreciation		$337 00
Wages		1,300 00
Feed (365 days)		730 00
Shoeing	$350	
Veterinary services	100	
Maintenance of vehicles	75	
Maintenance of harnesses	20	
Total maintenance		545 00
Interest on investment at 5 p. c		61 85
Insurance at 1½ p. c.		21 55
Cost to operate		$2,995 40

Assume that a four-horse team travels a total of 15 miles per day, and that a load is supplied only one-half the time, or in other words that there are 7½ carrying miles. With a load of seven tons, the ton mileage is 52½. This multiplied by the available days in the year, which may be taken as 275, gives a yearly ton mileage of 14,437. The yearly cost to operate, divided by this figure, gives the cost per ton mile as $0.208.

COST OF HAULAGE BY MOTOR TRUCKS.

Cost	$7,500
Depreciation at 15 p. c. per annum	$1,125 00
Interest at 5 p. c.	375 00
Insurance at 1½ p. c.	112 00
Wages	1,300 00
Fuel (275 days)	770 00
Lubricating oil at 50 cents per day	137 50
Spirits and waste	50 00
Maintenance and repairs	300 00
Cost to operate	$4,169 50

Assuming in this case that the machine runs 40 miles per day, of which, as above, only one-half the distance is covered with a load, the total ton mileage will be 200. This, multiplied by the 275 days, gives a total ton mileage of 55,000. Dividing the yearly cost to operate by the yearly ton mileage, the cost per ton mile of $0.0685 is obtained.

RADIO-ACTIVITY OF ORDINARY MATERIALS.

IT is now well recognized that the air in any ordinary vessel possesses the power of conducting electricity, although to a very slight extent. It has been usual to refer to the effect as the "spontaneous ionization" of the air. This name suggests that the conductivity is in some way an essential property of the air, just as the electrical conductivity of metals is inseparably connected with the nature of those bodies. Mr. C. T. R. Wilson, however, has found (Proc. Roy. Soc., vol. lxix. p. 277) that, when other gases are substituted for air, the relative ionizations are in nearly the same ratio as those which I observed for the same gases under the action of Becquerel radiation (Phil. Trans., 1901, p. 507). Further, Mr. J. Patterson (Proc. Camb. Phil. Soc., vol. xii. p. 44) has found that, when a large vessel is used, the amount of ionization is not proportional to the pressure, but tends toward a limit, when further increase of pressure no longer affects it. This is exactly the behavior that might be expected if the effect was due to a feeble radio-activity of the walls of the vessel, the radiation being easily absorbed by the air.

I have recently carried out a series of experiments with a view to decide whether the nature of the walls of the vessel had any influence on the rate of discharge of a charged body inside it.

The various materials were made into cylinders, 13 cm. long and 3.4 cm. in diameter. A central wire, charged, and connected with an electroscope, formed the leaking system. The electroscope was exhausted, so as to avoid any leakage through the air in it, and, before each experiment, the insulation, which was of lead-glass tube, dried by the exhaustion of the vessel in presence of phosphoric anhydride, was tested. No leakage could be detected. On admitting dried air, a small leakage immediately set in, and its amount could be measured by timing the movement of the gold leaf over the scale division of a microscope with micrometer eyepiece focused upon the leaf.

The leakage in scale divisions per hour, with various materials surrounding the charged wire, is given below:

Tin foil	3.3
Ditto, another sample	2.3
Glass coated with phosphoric acid	1.3
Silver, chemically deposited on glass	1.6
Zinc	1.2
Lead	2.2
Copper (clean)	2.3
Ditto, thoroughly oxidized	1.7
Platinum (various samples)	2.0, 2.9, 3.9
Aluminium	1.4

It appears, then, that there are very marked differences in the rate of the leak, when different materials constitute the walls of the vessel. There can therefore be little doubt that the greater part—if not the whole—of the observed ionization of air is not spontaneous at all, but due to Becquerel rays from the vessel.

It is, I think, interesting to find that the phenomena of radio-activity, which have generally been regarded as rare and exceptional, are really everywhere present.

The rate of leak with various pieces of tin foil from the same stock was always the same, as nearly as the experiments could show—that is, to within about 6 per cent. But, as may be seen in the table, a piece from another stock gave a different amount of leakage. The same holds good for platinum, one specimen tried being twice as active as another. It was found that ignition did not affect the radio-activity of a given specimen of platinum.

In order to compare the activity of the substances mentioned above with that of uranium, a small crystal of uranium nitrate, measuring 12 x 4 mm., was cemented to the inside of one of the cylinders; the rate of leak due to it was found to be thirteen times that due to the most active cylinder of platinum. The area of the uranium was only 1-240th part that of the platinum, so that its activity for an equal area would be no less than 3,000 times greater. It is possible that the radio-activity of ordinary materials may be due to traces of the more active substances. This would explain the varying activities of different samples of the same metal. Only an infinitesimal proportion of radium would be required. Radium is 100,000 times more active than uranium, and uranium 3,000 times more active than the most active common material that I have experimented with. So that one part of radium in three hundred million would suffice to account for the observed effects.—R. J. Strutt in Nature.

STEAM-TURBINES TO DATE.*

By R. H. THURSTON, LL.D., Dr.Eng., Director of Sibley College, Cornell University.

THE Beginnings of the Steam-Turbine.—The beginnings of the steam-turbine are found in the earliest historic times and in the earliest technical literature. Its progress is shown to be wholly modern and mainly recent. Only after evolution of the modern physical and mathematical sciences could its action be understood and the machine be properly designed; only after modern tools and methods of mechanical construction had become refined could it be built in safe and economical forms. The influence of the Alexandrian school upon modern engineering is shown to have been mainly through the philosophers who sowed the seeds of which we now see the germination and the fruit. They were necessarily dormant during the nearly two thousand years which elapsed between the days of Greek philosophy and modern, practically applied, science.

The Fundamental Ideas of the Theory of the Steam-Turbine are exhibited as embodied in the modern steam-turbine. The transformation of energy from its thermal into its dynamic form is traced and the principles controlling the thermodynamic change and the limitation of wastes are exhibited as exemplified, both for the ideal case of the perfect machine and for the practical construction of the day. The method of development of thermal energy is exhibited and the mechanism of the process of change into dynamic form is shown.

The turbine is discovered not to be a thermodynamic machine but to belong to the same class with the hydraulic turbine and its design, construction, and operation to be controlled by the same ultimate principles. The radical distinction between the types of the ancient Greek and of the engineer of the seventeenth century is pointed out and the influence of this difference in type upon the practical value of the invention is brought out. The limitations controlling the engineer in his design and construction due to this difference in type are exhibited and their effect upon the economic value of the turbine is shown. Notwithstanding these limitations it is found that the turbine is more nearly a "perfect steam-engine" than any other known type, so far as its design and construction are concerned. It remains to be seen what the practical outcome is to be.

The Economies and the Wastes of the Steam-Turbine are discussed and it is found that the machine, if its construction can be made perfect, will operate precisely as would its purely ideal representative. Its preliminary thermodynamic conversion of energy in the formation of its jet within the nozzle is exactly conformatory to the scientific theory of the case and the action of the turbine itself, receiving the jet, is that which a scientific and perfect construction would illustrate, in so far as energy conversion is concerned, if the apparatus be correctly proportioned and constructed.

It is discovered, on investigation, that the wastes of the turbine, as now illustrating the best work of the time, are apparently not far different in amount from those of the best work on the older type of steam-engine, the piston engine, but that these wastes are of a different sort and peculiarly distributed. The problem of their reduction is a radically different one from that of the older engine.

The Present Status of the Turbine as respects design is shown and its relation to the ideal standard of the engineer is examined into. The Hero turbine as used in "centrifugals," the Branca type as employed in the same class of machines, the old Avery and Atwater types, and the recent forms of De Laval and Curtis, Parsons and Rateau, are shown to approach the theoretical idea more completely than ever has or probably ever can any reciprocating engine. It does not necessarily follow that they will ultimately excel the common type of steam-engine in every-day practice; it simply means that to this extent they possess certain fundamental advantages. The fundamental principles of the steam-turbine being now entirely familiar to the engineer, its design has become one of the simple problems of construction and may be carried out with perfect comprehension of the requirements of the case as well as of the methods of successfully meeting those demands.

The now familiar types of simple and of compound turbine illustrate the familiarity of the engineer of to-day with this task. He recognized his limitations, as set by the weakness of his materials of construction and by the essential requirements for maximum thermal and mechanical efficiency which make demands upon him which are in precise opposition. He effects the best compromise possible in the one case and endeavors by a modified design to evade those limitations in the other case. Various expedients and various special devices, some of them amounting to real inventions, are found to be more or less successful in effecting this improvement, and the differences among the steam-turbines of the day are largely of this sort.

The fundamental principles of the compound tur-

* Abstract of lecture given before the New York Electrical Society, March 18, 1903.

bine are simple and all forms of such machines are fundamentally the same in principle.

The Performance of the Steam-Turbine of the Day, as observed by the lecturer and as shown by the work of many other investigators, is found to be excellent beyond the anticipations of the most sanguine among older practitioners. Figures presented show that the machine is about as economical as other engines of the same power, that its regulation may be made satisfactory and its adaptation to special purposes is remarkably perfect. It is found that while experience is not by any means as complete and judgment therefore not so well-based as with the more familiar types of engine, the conclusion is probably well justified that this form of steam-engine has come to stay and that it will find its field and a broad one in the engineering of the future.

Opportunities for Improvement are found, on investigation of the theory and of the performance of the machine, comparing the predictions of a pure theory with the results obtained in a refined practice, to be very large. The direction which these improvements must take is shown clearly by experimental research and the way is clearly visible to all scientific designers and inventors. It is easily shown that there are two, and practically only two, ways of securing further gain in the efficiency of the turbine, the one involving the refinement of the construction of the machine, the other relating to the treatment of the working fluid. The method is simple in its requirements, but the practical meeting of these requirements may involve some difficulties. However that may be, the designers of to-day are competent, well-informed, and have the scientific training needed. They may be expected in due time to attain a high degree of success.

The Characteristic Advantages of the Steam-Turbine in its now standard forms are, for certain purposes, peculiar and very important. The adaptation of the machine to driving high-speed machinery, to the turning of the armature or the field of the dynamo, to the purposes of the marine engineer, present promising problems. Their solution is already well advanced, in most cases, and we already know that the turbine may be made of use in the operation of machinery, as of alternating current generators in multiple, where the difficulties with other motors are found to be singular and serious. These advantages are illustrated by the details of the engine-trials and of scientifically conducted investigations lately effected.

The Trend of Progress and the Promise for the immediate future is in the direction of further gain in economy of the machine by suppression of leakage and of friction of fluid within its casing by improved workmanship and by securing a better working substance by freeing it from water and also by utilizing the process of superheating to increase the thermodynamic range. This means, however, improvement at the boiler rather than at the engine; which latter is fitted in all its forms to employ superheated steam of any temperature that can be practically furnished from the steam-generator.

The trend of progress at the moment is also toward the application of specially-designed and constructed turbines to special uses. It is probable that, gradually, forms will be adapted particularly to use in electric light and power "plants;" others will find employment as marine engines and still others to other varieties of work. The regulation and the adjustment of speeds constitutes a problem, already satisfactorily solved in some cases, but which requires some further consideration in adaptation of satisfactory regulating mechanism to some special forms of turbine and to some special uses.

The promise would seem at the moment to be the introduction very widely of a new type of prime mover which adapts itself in a peculiarly happy manner to purposes to which the common forms of steam-engine are not likely to prove as perfectly satisfactory. The indications are that the supply of power by means of this motor will be made as low as with the best types of reciprocating engine and possibly lower; while its simplicity of plan and ease of construction would seem to insure freedom from liability to either accident or depreciation of value to any important extent for long periods of time. The theory and the practical modification of theory in the design, construction and use of the machine are so well understood and the real so closely approaches the ideal that the engineer may readily see his way toward the solution of any practical problem of design that may be presented, while he also may as readily see a remedy for any observed defect of efficiency or of mechanical action. It should therefore be expected that such approximation of the ideal perfect machine as is possible will soon be attained; particularly as, already, the study of the theory and the observation of the practice of the time with this machine is now being made the task of an immense number of learned men of science, of able practitioners and of skillful constructors. Probably never, in the history of engineering, was so simple a machine made the object of investigation of so large a number of able men, inventors, constructors, engineers and men of science, and the subject of such extensive experimental research.

It is very possible that, through the development of this ancient device we may yet see the nearest approximation to ideal thermodynamic and mechanical efficiency in the group of heat-motors that man can attain.

A Motor Truck, for the conveyance of luggage from one point of the station to another has been introduced upon the Paris station of the North Railroad Company of France. This trolley has been designed by M. Sartiaux, the chief engineer of the electrical department of the railroad. Electricity is the motive power, and the truck is set in motion by the depression of a handle controlling the electric motor. The vehicle is mounted upon four wheels, and has a carrying capacity of one ton. It is steered by the porter, who walks in front. This truck is only fitted with one speed, but the inventor is experimenting with a second truck equipped with three speed gears, so that the progress of the vehicle can be accelerated or diminished as required according to the crowded or deserted nature of the platforms.

SOME CURIOUS CURES.

THE sea captain who, finding that his medicine chest lacked a supply of the particular mixture referred to in his book of directions as No. 15, made up a dose for a sick sailor by equal portions of No. 7 and No. 8, adopted a method of curing which, in comparison with many an accepted popular notion, ranks as an example of sound, scientific reasoning. Few medical students complete their course of training in the hospitals without hearing patients explain how much relief they have experienced from the application of the clinical thermometers under their tongues or their armpits, while at the same time they condemn the medicine given them as worse than useless. The rational person, viewing humanity from his own individual standpoint, proudly asserts that the days of the amulet, the talisman, the charm, and the mystical potion are gone forever before the spread of education and the consequent decay of medieval superstition; but the rational person would receive a rude shock were he able to see into the secret recesses of different men's minds. It is not necessary to turn to the records of the olden times for instances of quaint superstitions in the matter of cures, albeit a brief research will reveal some curiosities of belief that are as humorous as one could wish. The story of the man with the wooden legs who maintained that his corns gave him incessant trouble until he applied corn plasters to the ends of his "timber-toes" may, after all, not be so far-fetched as at first sight appears, for imagination goes a long way in many a case of physical ill as well as in the cure.

But what can be said of a man who, receiving a hurt from a weapon, poultices the weapon and leaves the wound to cure itself? Stupidity can scarcely go further, and yet in the seventeenth century the "sympathetic powder" was in great demand as a sure cure for injury received from a weapon. The method of treatment was very simple. The wound had to be closed up and left to itself, while the weapon which inflicted the hurt was copiously poulticed with the powder until the wounded person recovered. For many years the cure held the field against all comers, until some careless apothecary bound up the wound of an injured man, but forgot to poultice the weapon, with the result, astounding at the time, that the man recovered just as rapidly as he would have done had the sword blade been properly swathed in bandages and doctored with powder. The romance of the cure was hopelessly shattered by such an unexpected termination of the foolish apothecary's treatment, and the fame of the "sympathetic powder" faded into oblivion. But as in modern days there seems to be a recrudescence of faith in the curing nostrums of bygone days, a mention of the prescription of this powder may not be out of place. To prepare it, one is told: "Take Roman vitriol six or eight ounces, beat it very small in a mortar, sift it through a fine sieve when the sun enters Leo; keep it in the heat of the sun by day and dry by night, and marvelous cures can be done by it."

A more modern method of extraneous application of prescriptions is that afforded by many a seeker after outdoor relief. "Here is the prescription: rub it on his chest," said a dispensary doctor to a woman whose child was suffering from a chest affection, and a week later the woman returned with a complaint that the treatment had done no good, though she had "well nigh rubbed the skin off and worn the bit of paper to rags." Another patient came back cured and smiling, and told the doctor she would wear the medicine in future as a preventive, so well had it acted as a cure—and she showed him the prescription for a throat lotion he had given her tied around her neck in a handkerchief. This is a parallel to the old-fashioned notion that the fourth book of the Iliad was a certain cure for ague if applied to the head of the sick man, the underlying idea of the cure apparently being that language of such warmth and grandeur as Homer wrote was enough to cure a chill even when, as lifeless print, it was placed near the brain of man. Surely a graceful tribute to genius, though poor as physic for a sick man; as poor, indeed, as the potatoes and horse chestnuts which are carried by many sufferers from rheumatism, not only in outlying country districts, but in the very heart of busy latter-day towns and cities.

But it is in the matter of curing whooping cough that superstition still holds its own. Many are the unfortunate spiders that annually are pinned up in paper sugar-bags over the mantelpiece of nursery and sitting-rooms. As the spider dies, so will the cough pass away, the recognized version of the superstition asserts, and many will add the pleasing information that unless a spider is secluded in such a manner at the outbreak of the disease, the little patient will certainly suffer until May, whether the first whoop is sounded in April or June. A blue bottle with a pin through it is sometimes substituted for the spider, and may also do duty as a sacrifice for the removal of warts—but in curing warts there are enough superstitious practices to fill a book.

Confidence—extreme, explicit confidence—is the first essential on the part of the patient who submits himself to the tender mercies of the faith healer, whether the healing is performed by means of a spider, by anointing, or merely by the paying over of money for so intangible a method of treatment as the mental exercise of the modern Christian Scientists. This may, perhaps, account for the significant fact that investigators of the special cures alleged to have been effected by cure-mongers usually find 70 per cent of the persons cured have died almost as soon as the cures were completed. All cure-mongers are not so explicit as the inventors of the anodyne necklace, which was claimed to be an infallible remedy for the troubles of teething in infants, and was a harmless string of beads made from the roots of the henbane.

Neither do the majority of them compare with the advertiser who boldly announced that as jaundice was caused by little yellow flies flying about in the system, he cured his patients by giving them spiders' eggs to swallow, trusting to the heat of the body to hatch the eggs, with the result that the spiders spun their webs, caught and killed the flies and cured the jaundice, leaving only the cobwebs behind, a slight inconvenience which could be cured by a visit to the seaside, when the breezes would blow them away. There may have been more of jest than serious intent in the announcement, but still, at this modern period, sick children are carried fasting, on Sunday mornings, into three parishes, in some country districts; spiders' eggs are proclaimed by village wiseacres to be an infallible cure for jaundice; the hind legs of a toad, worn around the neck in a silk bag, are regarded as a panacea for all evils; and the best disinfectant and anti-contagion that the world can produce is, in the mind of many an old village wise woman, a metal-headed cane (gold-headed for preference) that has been carried on his professional rounds by a doctor.

SCIENCE AND THE COMMON WEAL.

IN a recent editorial the New York Evening Post declared that "one of the most striking features of the nineteenth century was the rapid increase of population, especially in the most highly civilized countries. From 1801 to 1900 the population of the earth grew from 900,000,000 or 950,000,000 to 1,558,000,000, or considerably more than 50 per cent; but this increase was due mainly to the growth of the population during the same period from 170,000,000 to 510,000,000 in Europe, America, Australia, and other lands settled chiefly by Europeans. At the time of William the Conqueror, in 1086, the population of England and Wales was 2,150,000; six centuries later it was 5,500,520, and in 1800 only 8,500,520; but from 1801 to 1901 it rose to 32,500,000. In Germany the increase was from 24,800,000 in 1816 to 56,300,000 in 1900, and in France, where the growth of population is relatively slow, it was from 27,300,000 in 1801 to 38,400,000 in 1900. Ireland is the only part of Europe that shows an actual diminution of population during the same period. This decline began in 1851, and is due to unfavorable political and economical conditions, famine and emigration.

"It is now nearly 100 years since Malthus published his 'Essay on the Principles of Population,' in which he asserted that the increase of population tends to overpass the means of subsistence, and that this disproportion necessarily leads to general destitution and starvation unless counterbalanced and corrected by the devastations of pestilence and war, the only other remedy of the evil being the voluntary or coercive restriction of propagation. From his point of view the material welfare of the people ought to have been much greater when the population was small than it is at present, but statistics show the reverse of this to be true. In an address entitled 'Volkswohlstand und Wissenschaft,' recently delivered by Prof. Brentano, rector of the University of Munich, on the 430th anniversary of the founding of this institution, the eminent political economist examines the Malthusian theory and explains why its pessimistic predictions concerning the future of mankind have not been verified.

"In 1794 more than 6 per cent of the men over twenty-one years of age in Bavaria were beggars. The peasants were virtually serfs, and it was forbidden by law to pay a laborer more than 15 kreuzers (about 10 cents) a day. Whoever offered more than this sum rendered himself liable to a fine of 10 thalers ($7.15), and the workman who demanded or accepted such high wages was condemned to eight days' imprisonment at hard labor and on bread and water, and to receive each day twelve stripes with the scourge. It is no wonder, as the Bavarian historian Westenrieder remarks, that the 'jails were crowded with culprits and the highways adorned with gallowses instead of fruit trees.' Since that 'good old time' the population of Bavaria has doubled, while the condition of the individual has constantly improved. Still more conclusive is the testimony against Malthusianism furnished by England, where the increase of population, accompanied by a corresponding increase of prosperity, has been greater than in any other country of Europe. According to the statistics tabulated by Sir Robert Giffen, the wealth of Great Britain and Ireland amounted in 1812 to £160 per head, and in 1885 to £270 per head. That this advance was not due to the enrichment of the rich, attended by the impoverishment of the poor, but benefited all classes, is evident from the fact that from 1840 to 1900 the average wages of the common workman rose from £43 to £100, or about 133 per cent. The fact that compassion for poverty finds stronger and more frequent expression with us than with our ancestors, and that more persistent and systematic efforts are made to relieve it, is not due to its greater prevalence, but to the clearer perception of its evils, the prevalence of a higher standard of living, a more correct conception of what is necessary to human comfort and stronger sympathy with all forms of suffering.

"The chief cause of the increase of population has been the decrease of mortality. From 1810 to 1820 the death-rate in Europe was 31.5 per 1,000; while from 1886 to 1890 it was only 27.3 per 1,000; in western Europe, where the progress of civilization was most rapid, the death-rate diminished during the same period from 28 to 23.4 per 1,000. In Germany it sunk from 28.8 per 1,000 in 1870-80 to 23.5 in 1891-1900. Malthus also maintained that every improvement in the conditions of human existence would be followed by a multiplication of marriages, and consequently of the human species by natural generation. This anticipation, however, has not been realized. The enormous increase of wealth during the latter half of the nineteenth century has not resulted in an increase of marriages. In England the number was 8.5 per 1,000 from 1851 to 1860, 7.5 per 1,000 from 1881 to 1890 and 7.9 per 1,000 from 1890 to 1900. In other parts of Europe this fluctuation is still more marked; but on the whole the number of marriages in proportion to the population, and also the average number of births to each marriage, has greatly diminished during the last decades of the nineteenth century. This is true not only of France, where the ideal of the family is to be attained by not having more than two children, but also of lands inhabited by more prolific races, as, for example, England, where the number of births to a marriage has fallen from 4.36 per 1,000 in 1884 to 3.63 per 1,000 in 1900. Taking these factors into consideration, the extraordinary increase of population in recent times must be ascribed to the diminution of the death-rate, and especially of infant mortality.

"The question now arises why the principle enunciated by Malthus and accepted by the most prominent

political economists of his day should have been so greatly qualified by subsequent events, the increase of population, so far from producing general distress, having been attended by a still greater increase of human welfare, the people being better provided with the means of subsistence at the present time than they were a century ago. This favorable result we owe to what Malthus could not foresee, namely, the evolution of modern science and its practical application for the relief of human wants, especially in the production of food. We need only mention the progress of agriculture, to which organic chemistry and physics have so largely contributed; the social amelioration attending technical and industrial development, and commercial expansion by the aid of forces, such as steam and electricity, which make the remotest regions of North and South America and Australia convenient market places for supplying the daily needs of the densely populated cities of Europe; and the efficiency of medical science, jurisprudence, and ethics in promoting longevity by sanitary regulations, inculcating justice and equity, and elevating the standard of morals, thus leading to the relative decrease of crime.

"It is only to countries unaffected by the progress of science that the Malthusian theory may be said to apply. Outside of Europe and nations of European origin, or under European influence, like British India and Japan, the population, according to the statistics of Sir Robert Giffen, remains very nearly stationary. In British India the number of inhabitants has increased during the last century from 150,000,000 to 294,000,000, and in Japan, since 1870, from 31,000,000 to 45,000,000."

TRAPS OF THE AMERICAN INDIANS—A STUDY IN PSYCHOLOGY AND INVENTION.

By OTIS T. MASON.

MEANING OF THE TERM AMERICAN.

AMERICA, in this connection, embraces all of the Western Hemisphere visited by the native tribes in their activities associated with the animal kingdom. It might be well to exclude a small number of frozen or elevated or desert regions untrodden by human feet, were it not for the fact that most of these were the resorts of zoomorphic gods, creatures of the aboriginal imagination. The name America must in this study include also those oceanic meadows stretching out from the continents, whereon were nourished innumerable creatures, which dominated the activities of the littoral tribes.

DEFINITION OF THE TERM TRAP.

A trap is an invention for the purpose of inducing animals to commit incarceration, self-arrest, or suicide. In the simplest traps the automatism is solely on the part of the animal, but in the highest forms automatic action of the most delicate sort is seen in the traps themselves, involving the harnessing of some natural force, current, weight, spring, and so on, to do man's work.

In capturing animals by the simplest methods they are merely taken with the hand as in gathering fruits. By a second step they are harvested with devices—scoop nets, dippers, seines, hooks that are substitutes for the crooked finger, reatas, dulls, bolas, and many more. A third step leads to active slaughter with clubs for bruising, knives and axes for cutting and hacking, and with a thousand and one implements for piercing and retrieving. In these the hunters are present and active, making war on the animal.

In the matter of automatism there is no great gulf between the trapper and the hunter. At both ends and in the middle of the trap's activity the man may be present, but not to the victim. Not waiting for the victim to go to its doom of its own will, the hunter, having set his trap, proceeds to entice and compel the game. He has learned to imitate to perfection the noises of birds and beasts—it may be of those he is hunting, of others hunted by them, or their enemies. He knows the smells that are agreeable and the dainty foods most liked. On the contrary, he also knows how to allay suspicions in one direction, to arouse them in another—always with the trap in his mind.

The action of the trap itself is also frequently assisted by the hunter out of sight. He releases the pent-up force of gravity, of elasticity.

Finally, the result of the trap's action is to hand the victim over to the hunter to carry away or kill. Often the trap does the killing outright, and the result is raw material for the elaborative industries; but in other cases the hunter must be near by to give the coup de grâce. The instances are many where the victim must be dispatched at once, or the trap will be destroyed and the result lost.

THE TRAP AS AN INVENTION.

As intimated, the trap teaches the whole lesson of invention. At first it is something that the animal unwittingly treads on (Middle Low German, treppen, to tread; tramp is a kindred word). At last it is a combination of movement and obstruction, of release and execution, which vies in delicacy with the most destructive weapons. Gravity and elasticity are harnessed by ingenious mechanical combinations.

THE TERM PSYCHOLOGY.

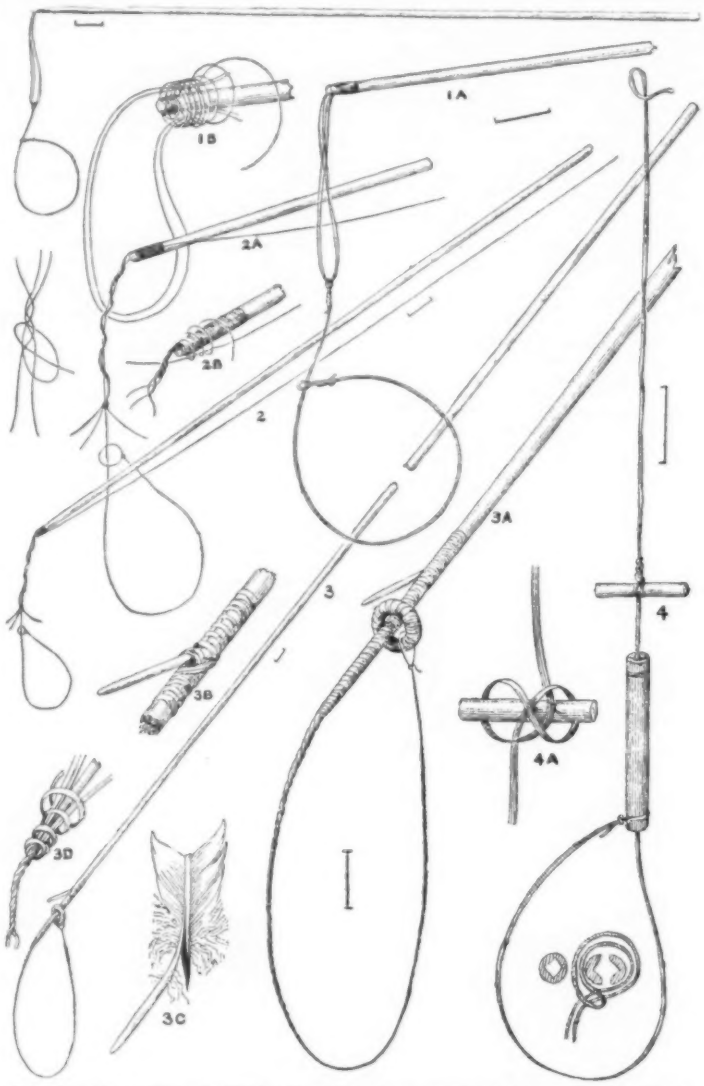
In this paper the term "psychology" stands for all those mental processes that are caused and developed by trapping. There is the mental activity of the animal and that of the man. The trap itself is an invention in which are embodied most careful studies in animal mentation and habits. The hunter must know for each species its food, its likes and dislikes. A trap in this connection is strategy. Inasmuch as each species of animals has its own idiosyncrasies, and as the number of species is unlimited, the pedagogic influence of this class of inventions must have been exalting to a high degree for the primitive tribes.

The varieties of execution to be done by the trap were very great. It had to impound or encage, or to seize by the head, horns, limbs, gills; to maim, crush, slash, bruise, impale, poison, and so on, as though it had reason—the thought of the hunter had to be locked up in its parts ready at a touch. As population increased, wants became more varied and animals became more scarce, more intellectual and wary. If any reader of this may himself have been a trapper he will remember the scrupulous care with which he proceeded at every point, to make the parts stable or unstable, to choose out of innumerable places one that to a careful weighing of a thousand indications seemed best, to set the trap in the fittest manner, and at last to cover his tracks so that the most wary creature would not have the slightest suspicion.

To catch a fox it was necessary to win its confidence, and this the savage knew. So he prepared a trap that was perfectly harmless, and let Reynard walk about over the ashes or fresh earth or chaff, picking up dainty bits until all suspicion was removed. Then was the time to conceal the trap. But all vestiges of human hand or foot must be removed, and the apparatus must be cleaned and smoked most effectually.

PARTS OF TRAPS.

The trap has two classes of parts, the working part and the mechanical, manual, animal part. The victim finds itself in a pound, deadfall, cage, hole, box, toil, noose, or jaw; on hook, gorge, pale, or knife, and so on. This dangerous element, to repeat, may not need any accessories. The fish swims into a fyke, the animal walks into a pit or pound, the bird or climbing animal finds itself in a cage with ratcheted entrance to prevent egress; that is all.



TRAPS OF THE AMERICAN INDIANS. STEPS OF AUTOMATISM IN THE GRASPING DEVICE.

1. Common dull. 2. Dull and tickler. 3. Dull and ratchet. 4. Complex moose trap.

In a higher stage of invention, where the forces of gravity and elasticity are invoked to do the incarceration, arrest, or execution, there has to be found between the lure and the execution a host of devices, and these form an ascending series of complexities. The simplest of these intermediary inventions is an unstable prop or support of some kind; the slightest pull at a bait removes the ticklish thing, and weight or noose, or other deadly part, is set free. The trigger and the catch are more complicated and varied; the secret of them all, however, is that an unstable catch is released by the animal in passing, in prying curiosity, in gnawing, or in rubbing; this is connected by means of sticks and strings to the last release, since the operation of releasing is in connection with the device in which the force is confined and by which the work is to be done. In the highest forms of weight traps and spring traps there are veritable machines, since they change the direction and effect of motion. It is on these that most ingenuity has been expended, and in them is exhibited that wonderful threefold play of working force, work to be done, and processes of reaching the end. Variations in the materials utilized will play no mean part, also, in a continent covering all zones save the antarctic, all elevations at which man can live, and all varieties of vegetal phenomena growing out of temperature and rainfall. To proceed with some order it will be necessary to divide the Western Hemisphere into convenient culture areas. The following will serve for a provisional list:

American Culture Areas.

Areas.	Peoples.
1. Arctic	Eskimo.
2. Canadian	Athapascan.
3. Atlantic slope	Algonquian-Iroquois.
4. Mississippi Valley	Siouan.
5. Louisiana or Gulf	Muskhogean.
6. Southeastern Alaska	Haida-Koluschan.
7. Columbian region	Salish-Chinookan.
8. Interior basin	Shoshonean.
9. California region	Very mixed stocks.
10. Pueblo region	Tanoan-Tewan and Sonoran.
11. Middle American	Nahua-Mayan.
12. Cordilleran region	Chibcha-Kechuan.
13. Antillean region	Arawak-Caribbean.
14. Upper Amazonian	Jivaro, Peba, Puno, etc.
15. Eastern Brazilian region	Tupi-Guarani, Tapuya.
16. Mato Grosso and southward	Mixed people of Brazilian and Andean types.
17. Argentina-Patagonian region	Chaco, Pampean, and Patagonian stocks.
18. Fuegian region.	Aliculuf, Ona, and Yahgan.

The inquiry will not be raised here whether the traps not made of metal and found in the hands of the American savages are entirely aboriginal, or whether there has been acculturation. A good knowledge of the traps as they exist or existed will go far toward settling the question of origin.

CLASSIFICATION OF TRAPS.

Traps are variously classified according to the concept in the student's mind. If it be the natural element in which they work, there will be land traps for mammals, birds, reptiles, and invertebrates; water traps for mammals, birds, reptiles, fishes, and invertebrates; and air traps for birds and insects.

With reference to their parts, either mechanical or efficient, there are a multitude of names which will appear in a separate vocabulary. In the setting they are man-set, self-set, ever-set, and victim-set.

For the purpose of this paper traps may be divided into three groups, namely: (A) Inclosing, (B) arresting, (C) killing. In each of these we may begin with the simpler forms—those with the least mechanism—and end with those that are more intricate.

A.—Inclosing Traps.

(a) Pen—dam, pound, fyke.
(b) Cage—coop, pocket, cone, fish trap.
(c) Pit—pitfalls.
(d) Door—with trigger, fall cage, or fall door.

B.—Arresting Traps.

(e) Mesh—gill, toils, ratchet.
(f) Set hook—set line, gorge, trawl.
(g) Noose—snare, springe, fall snare, trawl snare.
(h) Clutch—bird lime, mechanical jaws.

C.—Killing Traps.

(i) Weight—fall, dead fall.
(k) Point—impaling, stomach, missile.
(l) Edge—wolf knife, brain knife.

A.—Inclosing Traps.

Inclosing traps are those which imprison the victim, most of them without doing any further bodily harm, though there may be added to these some other devices which will injure or kill. There are four kinds of inclosing traps: (a) Pen traps, (b) cage traps, (c) pit traps, (d) door traps.

(a) Pen Traps.—These include pounds or corrals on land, and dams, fish pens, and fykes in the water, the idea being simply to inclose. Traps of this sort have no tops and therefore are not useful for birds. In connection with other forms, small inclosures are used to surround the bait and to guide the victim in a certain direction. How the animal gets in, how it is kept in, and what is done to it afterward will decfde whether the pound is a trap or a corral or whether it is a reservoir, an abattoir, or a domesticating device. The simplest form of pound is of brush or reeds, and confines whatever enters, large or small; but the perfect form has interstices carefully adapted to retain certain species and to allow others to escape, or holds the adult individual in and lets the small and young out. The savage tribes, further, could make movable walls of reeds and long nets. Indeed, the great impounding nets are the last word in the series. Add to the pound an entrance and there begins another set of inventions around the notion of shutting. A gateway may be closed by nature or by device. The tide falls and leaves aquatic creatures imprisoned. Animals get under some obstacle and can not surmount it. They corral themselves. A gateway may be guarded by sentinels also, but gates may be intentionally shut or a pound-shaped barrier be set up, so that the return of those which pass in is impossible. Most pounds, whether in water or on land, have some natural or artificial lane for conducting the game to the gateway. On either side may be precipices, trees with ropes or wattles between wing nets, or something of the kind, along which animals pursue their natural course and are lured or driven to the pen (Fig. 2).

(b) Cage Traps.—In this class must be grouped all forms of coops and strong house traps on land, and a great variety of cones, pockets, and fish traps in the waters. All of these are designed for climbing, flying, or swimming creatures. The cage or coop trap, completely inclosed on every side, is a step in advance of an open pen, whether on land or in the water. The majority of cage traps have funnel-shaped entrances, into which the animal passes easily and unrestrained, but exit is prevented by means of a pointed strip of wood or other substance acting as a ratchet; or in the case of nets, the small end of the funnel consists of a series of string gates which the animal passes, and these close the mouth of the net so as to prevent escape (Fig. 3).

Among the Eskimo a unique contrivance for catching foxes was a net which was made to be set around a burrow, in the corners of which were long pockets, opening wide into the net, but gradually contracting until the fox could go no farther. Endeavoring to turn back, it became hopelessly entangled and died of fright and cold.

(c) Pits.—The digging of pits was not common in America before the discovery, owing to the lack of metallic excavating tools. Pits partially dug out and partially built up were seen here and there as a blind for the hunter, who concealed himself therein. Boas, quoting Lyon, describes an Eskimo fox trap in the snow into which the animal jumped and was unable to extricate itself.

The central Eskimo, according to the same authority, dig a wolf trap in the snow and cover it with a slab of snow on which the bait is laid. The wolf breaks through the roof, and as the bottom of the pit is too narrow to afford him jumping room, he is caught.

The Cree, in the Saskatchewan country, place at the end of their deer drives a log of wood, and on the inner side make an excavation sufficiently deep to prevent the animal from leaping back.

Pitfalls are said to have been used by the Indians of Massachusetts. They are described as oval in shape, 3 rods long and 15 feet deep.

The Concow Indians of California are said to catch grasshoppers for food by driving them into pits. The Achomawi, or Pit River Indians, dug deer pitfalls 10 or 12 feet deep by means of sticks, and carried the earth away in baskets. In southern Brazil, also, wild beasts were caught in pits dug for that purpose and covered with leaves.

(d) Door Traps.—The last form of inclosing trap to be mentioned here is also the most mechanical; it includes those in which a door falls and incloses the animal, or in which a cage, one side of which is held up by an unstable prop, falls and incloses the victim.

Parry describes a small house trap, made of ice and used by the Eskimo for foxes, at one end of which was a door made of the same material, to slide up and down in a groove. This door was sustained by a line which passed over the roof and was caught inside on a hook of ice by means of a loose grommet to which the bait was fastened. The fox, pulling at the bait, released the door of ice and found itself in prison.

Crantz describes a house trap used by the Greenlanders in which a broad stone forms the movable door. I have seen a trap of similar mechanism used by folks in eastern United States, in which a cage or basket is propped up with a loop of splint; this pulled inside by the animal tugging at the bait, brings down the cage over the victim. Doubtless this form of imprisoning animals designed to be taken alive was quite well spread over the continent.

B.—Arresting Traps.

The arresting traps are designed to seize the victim.

(e) Mesh Nets.—The mesh net is based on the fact that animals, by the conformation of their bodies or by the set of the hair, feathers, or gills, may ratchet themselves. To this class belong "toils" for land animals, trammels and gill nets for aquatic animals.

Among the archæologic treasures of our National Museum are many net sinkers, which would lead to the conclusion that netting is an old art among the aborigines. The majority of netting devices are for aquatic animals, but tribes on the coast of British Columbia suspend nets between poles in order to capture migratory geese and ducks. The Eskimo make nets of sinew, or rawhide, and of baleen; these are set across the rivers in open water, but more ingeniously under the ice by means of holes cut at such distances apart as to enable the fishermen to draw the net out and in.

A device somewhat in the nature of this is used by the Eskimo of Point Barrow for catching seals; four holes are drilled through the ice about a breathing hole; from these a net is set under the breathing hole, the lines being worked through the four corners of the space; the net is hung under the ice, and the seal coming to breathe is entangled therein.

Gill nets are set for seal after the ice forms along the shore. Murdoch reports that smaller seals are captured also in meshing nets of rawhide set along the shore in shallow water; he thinks that the meshing nets in northern Alaska came from Siberia.

Elliott illustrates Eskimo women catching salmon in a gill net consisting of a pole and a triangular net attached. The pole rests on a stone at the water line, while the net sinks in the water; as soon as a fish strikes, the women lift the pole, extricate the fish, and reset the net.

Mesh fishing is also quite common among the Athapascan tribes, both on the Yukon and on the Mackenzie. Charlevoix states that in St. Francis River, Canada, the Indians made holes in the ice, through which they let nets five or six fathoms long; he also describes the taking of beaver by means of nets.

(f) Set Hooks.—These may be employed on land or in the water. A toggle or gorge may be so baited or placed that a duck or a goose, by diving and swallowing it, may be held under the water and drowned. A single hook may be set for vermin, or baited and left in the water, especially for large fish; for the smaller fish, the trawl or trot line holding several hooks may be stretched across a body of water, and thus the game may be secured in the absence of the fisherman.

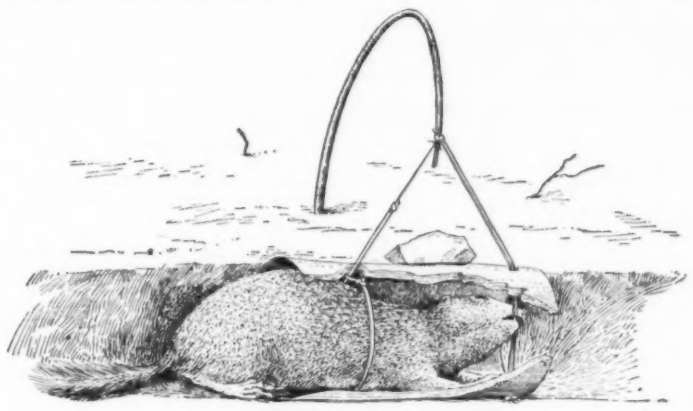


FIG. 1.—MARMOT TRAP.

FIG. 3.—FISH TRAP.

FIG. 4.—GAME SPITS.

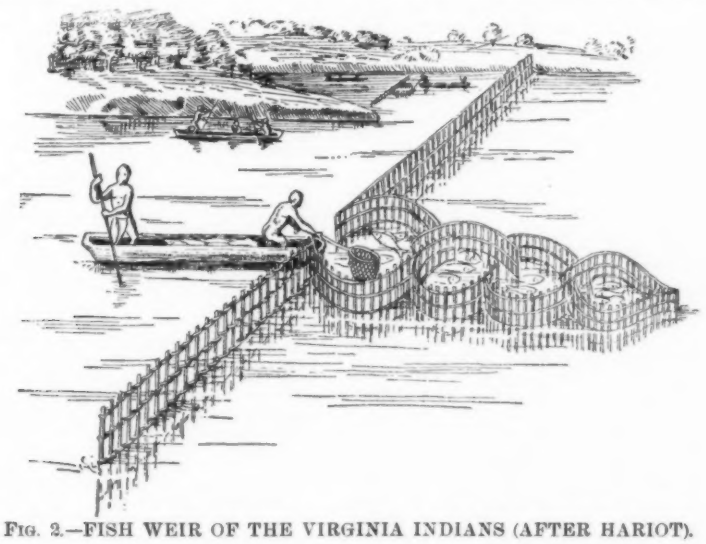


FIG. 2.—FISH WEIR OF THE VIRGINIA INDIANS (AFTER HARIOT).

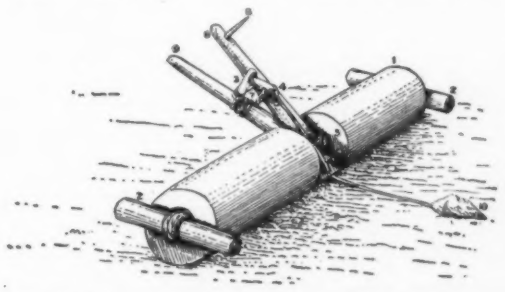


FIG. 5.—FOX OR WOLF TRAP WITH SINEW SPRING.

In one sense, many hooks used in taking birds and fishes are traps. They are baited and cast into the water or placed in such position on land that the hunter is out of sight. A line is attached to hooks of this kind, one end of which may be held in the hands of the hunter or tied to a buoy or other signal device.

It is interesting to note that fishhooks are not found in many American areas—large regions are entirely devoid of them, and in ancient mounds and works such relics are wanting. No picture of a fishhook is seen in any Mexican or Maya codex, and Von den Steinen notes the entire absence of fishhooks from large places on the affluents of the Amazon. The simplest form of this class of devices was seen by Lumholtz among the Tarahumari in northern Mexico; they catch blackbirds by tying corn on a snare of pita fiber hidden under the ground; the bird swallows the kernel, which becomes toggled in its œsophagus, and cannot eject it.

In the order of complexity—a removal from the mere action of hand hooks for capture—hook traps may be divided into the following classes: The seed on a string; the gorge; hook at the end of a string, squid hook; baited hooks; compound hooks; barbed hooks; and automatic hooks.

(g) Noose.—This is a most interesting class of traps. A string or thong or rope, or a bit of whalebone and sinew, may have one end looped around itself so as to slip with perfect ease; the other end will be fastened to some object. This noose may be so placed that the animal will run its head or its foot into it and be caught; or it may be attached to a bent sapling or some form of springe which is held down by a device, to be liberated by the animal coming to seize the bait or lure. In order to prevent the animal from gnawing the snare, perforated sticks may be suspended just over the knot, thus making a very complicated device. The noose may be used in the air for birds on the wing, on the land in many ways, and sparingly in the water.

Boas says that among the central Eskimo waterfowls of all descriptions are caught in abundance in whalebone nooses fastened to a long whalebone line or to a thong. Hares, ermines, and lemmings are also taken in whalebone snares. E. W. Nelson describes a noose for catching Parry's marmot, which involves a form of release mentioned also as used among the Iroquois. The victim enters the leadway as usual, and instead of pulling at the bait to release the spring, it gnaws in two a string which holds the snare down and which has something on it appetizing to the animal. In the Iroquois rabbit trap the string is steeped in salt (Fig. 1).

The simplest nooses at Point Barrow are made of baleen and set around where fine gravel has been placed to attract the birds. Accounts are also given of nooses of whalebone set in water along the shores where ducks dive for their favorite plants, and which catch the birds by the neck. This reminds one of the use of the mesh net for the same purpose in California. From Nelson and other observers among the Eskimo, and from the examination of collections in the museums, it is learned that the methods and places of setting a noose are limited only by the habits of the different animals.

In the Mackenzie River country, and wherever the Hudson Bay Company's people have prosecuted their work, the snare and the springe are very commonly employed. Even reindeer and moose are strangled by means of snares set in their way. Father Morice figures in the Transactions of the Canadian Institute, 1894, a great variety of applications of the noose.

In Wood's New England Canaan we have the quaintest description of a New England trap:

"The Salvages take these in trappes made of their naturall Hempe which they place in the earthe where they fell a tree for browse and when he roundes the tree ,for the browse if hee tread on the trap he is horsed up by the legg by means of a pole that starts up and catcheth him."*

The gentleman of Elvast gives the following description of the trap among the Autiamgue tribes:

"With great springes which lifted up their feet from the ground; and the snare was made with a strong string, whereunto was fastened a knot of a cane, which ran close about the neck of the conie, because they should not gnaw the string."

Teit, in his account of the Thompson River tribe,‡ describes deer fences and springes used in catching large and small animals. Mrs. Allison describes snares for catching deer and birds in the same region. This custom prevails also in California among many tribes described by Frost and Powers. Zuñi boys catch blackbirds with snares made of horsehair fastened to a rope; these snares are laid on the ground and seeds placed between. When the birds alight they put their feet into the snare and are drawn up and captured. The older Zuñis drive sunflower stalks into the ground and fasten a noose on the top. When a hawk, watching for field mice, alights on the stalks, its feet are ensnared; being unable to rise, the hawk remains stupidly on its perch and allows itself to be captured.

The Tarahumari of Chihuahua are very ingenious in trapping rats, gophers, and deer. The ancient inhabitants of Copan caught quetzal birds in snares, and having plucked their beautiful feathers, set them at liberty again. In southern Brazil birds were snared by the feet, by the neck, and by the body. The Fuegians also use baleen nooses, which are set hidden in the grass for the purpose of catching partridges and other birds.

(h) Clutching Devices are best exemplified by bird lime. The ordinary jaw trap of the hunters may be placed in this class; the common steel rat trap is a good example. It is possible that spring nets may have been used in certain parts of America before the discovery, but the principle involved in the metallic clutching traps was not known.

C.—Killing Traps.

The principles involved in killing traps are those mentioned under "hunting," as crushing, piercing, and cutting.

(i) Weight Trap.—The simplest form of killing trap is the dead fall, in which a heavy weight drops suddenly upon the animal, destroying its life. The most interesting parts of the dead fall are the inventions for securing an unstable support of the weight and for releasing this support by means of the trigger or bait contrivance. There are few separate accessory appliances to the dead fall, since the animal is slain outright.

The fall trap was found in several of the areas mentioned. Essentially, in its least common form, it consists of five parts: A heavy weight to crush the animal, a fixed support (perhaps a stake in the ground), an unstable support on which the weight rests, a catch which prevents the weight from falling until the bait is nibbled or the string pulled, and, lastly, the trigger itself. The Central and Western Eskimo form of dead fall has a slab of ice as a crushing weight. The Hudson Bay Company's native trappers have a great variety of this particular type.

Maximilian figures a dead fall used for bears in Pennsylvania. The animal walks between two logs. Above are two logs fastened firmly together. These are held up by a crossbar supported between two sticks. A lever attached to the log passes over the crossbar and is held down at either end in a ratchet, where there is a bait. The bear crouches between the logs, pulls the trigger, and releases the lever, which flies up and lets the ring that supports the fall slip off; then comes the tragedy.

Similar traps are noted in British Columbia and throughout the southwestern country, but not in middle America nor in South America. The Hopi of Arizona, according to Dr. Hough, have two very primitive forms of dead fall; one, for foxes, consists of a heavy stone slab worked between two upright slabs for wings. One end of the prop rests above against the stone; the other end rests on a cobblestone beneath. The least touch of the prop rocks the cobblestone and lets the weight down upon the fox. In another form, used for taking birds, the box and the fall, or stone slab, are similar. The release consists of the following parts: First, the upright and the notched catch, precisely as in figure 4 traps. To the bottom of the notched catch a short string is tied, having at the other end a small wooden toggle, which is held by a little rod resting against it and caught at its other extremity in the grains of the sandstone slab. The least touch overcomes the friction between the trigger and the slab. This sets free the toggle, which unwinds from the post, the hook catch flies up, and the weight falls.

(k) Point Traps of the highest order were not common in America; that is, the use of arbalest or bow for the purpose of driving an arrow or bolt into the victim or for impaling, or the use of sharpened sticks in the pathway of land animals; but the throwing in the way of carnivorous animals of sharpened whalebone splinters wrapped in fat was practised.

Bancroft mentions a bear trap, used by the Aleuts, consisting of a board 2 feet square and 2 inches thick, furnished with barbed spikes, which was placed in Bruin's path and covered with dust. The unsuspecting bear stepped upon the smooth surface, when his foot sank and was pierced by one of the barbed hooks. Maddened with pain, he put forth another foot to assist in pulling the first away, when that, too, was caught. When all four of the feet were spiked to the board the beast fell over on its back and its career was soon ended by the hunter.

The wolf bait, made of a piece of whalebone sharpened at both ends and doubled up, has been mentioned by Boas, and examples of the same device were brought to the National Museum by Nelson from St. Michael, Alaska (Fig. 4).

Lumholtz says that the Tarahumari catch deer by putting sharpened sticks in the track and stampeding the animals with dogs.

(l) Edge Traps.—There were in America two forms of knife or cutting traps of the most ingenious character. One may be called the wolf knife. A sharpened blade was inclosed in a frozen mass of fat and stuck up in a block of ice. The wolf, licking the fat, cut its tongue. The taste of the blood infuriated the animal, so that by licking the knife more it caused a larger flow of blood. All the other members of the pack were attracted to the same spot, devouring one another for the sake of blood, till all were destroyed.

Another form of edge trap is found in Alaska, where the blades are attached to one end of a lever, the other end of which is inclosed in a torsion spring of rawhide. The animal stops to pick the bait, pulls the trigger, and releases the unstable hook catch; the knives fly over and the victim is brained (Fig. 5).

* New England Prospect, Prince Society; Boston, 1865, p. 202.

† Hakluyt, Voyages, Vol. III, p. 114.

‡ Memoirs of the American Museum of Natural History, Anthropology, Vol. II, pp. 247-249, figs. 238, 239.

A TEST WITH CARRIER PIGEONS FOR WAR PURPOSES.

EXTENSIVE experiments with carrier, or homing pigeons, says the New York Sun, were recently conducted in Rome, and attracted considerable attention in the military world. A Belgian society sent 114 cages, containing 2,835 homing pigeons, to Rome. These were to be tested in the presence of a number of Italian officers of high rank.

On each pigeon a number and a brief description were fastened (either on the wing or the tail), together with a written request to the effect that any one finding it should let it fly again after feeding. Based on former experiments it was assumed that the entire collection of pigeons would reach their respective homes in Antwerp, Brussels, Charleroi, Mons, Seraing, and Liège, within 48 hours. High hopes were entertained when the first pigeon reached Seraing, covering a distance of 730 miles in 27 hours, and when a little later another arrived in Brussels. But these hopes were doomed to disappointment. One of the pigeons turned up in Bavaria, and another in Sicily, and it was not until considerable time had elapsed that 135 of the pigeons reached their homes. The rest apparently died of cold and hunger.

In 1878 similar experiments resulted in about the same proportion of losses, but it was hoped that, in view of the uninterrupted efforts that have been made since then to increase the value of homing pigeons, better results would be obtained in these experiments just made.

INCREASING THE POWER OF GASOLINE MOTORS BY THE INJECTION OF WATER INTO THE CYLINDERS.

TESTS OF THE BANKI MOTORS.

A NUMBER of tests were recently made by Prof. Schimanek on the improved internal combustion motors designed by Donat Banki of Budapest. The following is a description of them:

To permit the use of high compression without the danger of premature ignition Herr Banki injects into the charge of combustible mixture a spray of water, finely atomized, which mingles with the charge as it is drawn into the cylinder. The presence of moisture raises the temperature of ignition very materially, so as to avoid the danger of premature explosion. The moisture is expanded by the heat produced by the explosion, and its expansive power is added to that of the charge, thus returning as mechanical power the heat it absorbs, and the thermal efficiency is unaffected by the presence of water.

Prof. Schimanek examines the thermal conditions dependent upon the use of different percentages of moisture, for a compression of the charge to one-tenth of its initial volume, and shows that for constant specific heat the temperature of the charge without the water would be 1,030 deg. C., giving a theoretical thermal efficiency of 61 per cent, while with a ratio of 0.08 of moisture to air, by weight, the temperature of compression is lowered by 530 deg. C., and the theoretical thermal efficiency still remains as high as 58.4 per cent.

Prof. Schimanek describes in detail tests upon Banki motors using as fuel benzine, alcohol, and gas. Indicator diagrams show a compression pressure of 12 to 15 atmospheres and explosion pressures of 35 to 40 atmospheres, while the thermal efficiency per brake horse power is as high as 31 per cent.

The improvements in the present motors over those of earlier design are mainly in mechanical construction and in the apparatus for spraying the water into the entering charge, the principle of the machine being practically the same as that originally shown at the Paris Exposition of 1900. The present engines, however, are of small power, ranging from 3 to 10 horse power, which renders the big thermal efficiency the more notable.

An interesting phase of the experiments described by Prof. Schimanek appears in the adaptation of the principle to the motor of an automobile. A gasoline vehicle of the well known De Dion-Bouton construction was taken and the cylinder head of the engine removed and replaced by another constructed so as to increase the compression from 1:3.6 to 1:5.81, and a device for spraying water into the charge was attached. Brake tests of the motor showed an increase in capacity of about 30 per cent, while the cooling effect of the water was very marked. It is probable that this principle may therefore prove of value in connection with motors of vehicles as well as for stationary service.

The De Dion motor experimented with was an air cooled one of 66 millimeters (2.64 inches) bore and 69 millimeters (2.76 inches) stroke. It was so altered that when the crank was in the inner dead center the piston head was only 2 millimeters from the cylinder head. Without the injection of water the motor would not run with this alteration. The ratio of compression before the change was made was 3.6:1 and after the change 5.81:1, the ratio for regular large size Banki motors being 10:1. Originally the motor developed 1.2 horse power, and, after being changed as described, 1.57 horse power, both at 1,500 revolutions per minute. The same proportional increase in power was observed at higher speeds. The consumption of water was equal to about one-half the consumption of gasoline. The electric ignition operated as regularly as usual.—Zeitschrift des Vereins Deutscher Ingenieure.

TEA AND COFFEE IN INDIA.

IT is only when the figures are tabulated that one can appreciate the enormous proportions the Indian tea trade has attained. Last year there were 524,767 acres, producing 191,250,000 pounds of tea, representing an invested capital of $54,000,000. The period of greatest activity was in the years 1897 and 1898, when 67,000 acres were added to the tea-growing area. This expansion, without corresponding increase in the demand, bore fruit in the glut which has in recent years brought prices down below a fair profitable level, and consequently a reduction of the rate of progress set in. Last year there were only 2,284 acres added. The price of tea in 1902, although higher than in 1901, was lower than at any other time during the past thirty years. The ruling price at Calcutta during the public sale was about 14 cents a pound for broken Pekoe, and unless there is a considerable advance in values, which is unlikely, the poorest-yielding lands must fall out of cultivation. The United Kingdom is still the greatest repository for Indian tea, taking nearly 160,000,000 pounds of the total production; it is difficult to say how much of the tea exported to London finds its way to America. Australia comes an extremely poor second, with 8,500,000 pounds. France and Russia are the only countries whose demand shows a promising development. The popularity of "le five o'clock" has run the consumption in France up to 75,000 pounds a year. India consumes only 5,500,000 pounds of home-grown tea and 3,000,000 pounds of foreign. The planters have neglected the Indian market in their anxiety to stimulate the demand from abroad. Canada, with its 5,000,000 inhabitants, consumes as much Indian tea as does the United States, with a population fifteen times as great; each consumed last year about 1,075,000 pounds. Southern India practically monopolizes the Indian coffee industry. The low prices caused by the competition of the Brazilian coffee have played havoc with this trade in recent years, and the average production in the last quin-

quennium was under 20,500,000 pounds, as compared with 34,750,000 pounds in the preceding five years. This great falling off in the output is due rather to a diminished yield than to any reduction of acreage, for the extent under coffee is practically the same as in 1885, while the output is less than half. The coffee producers have seen the price of their commodity fall for the last twelve years. In 1890 it was £5 6s. 2½d. ($25.63) per hundredweight (112 pounds), and in 1900 it touched bottom level with £2 7s. ($11.67). It is not easy to determine how much of the 250,000 pounds of Indian coffee shipped to Arabia finds its way to Europe and America as the finest "Mocha."—Bradstreet's.

TRADE NOTES AND RECIPES.

To "Oxidize" Silver.—The "oxidation" of silver is a very simple operation, still there is some little skill necessarily involved in putting a handsome black finish on the object after treatment. The Journal der Goldschmiedekunst gives the following directions: Into a cup of hot water put about ten grains of liver of sulphur (potassium sulphide) and mix well. Into this plunge the object to be colored, after first making it as white as possible with the scratch brush, and let it remain there for about two minutes. Take it out, then rinse it with clear water, use the scratch brush on it again, and return it to the still warm bath. Let it remain for a similar length of time, then repeat the operation of scratching off and returning to the bath. A third immersion is usually sufficient to produce a fine black "oxidation."—Druggists' Circular and Chemical Gazette.

Bronzing for Brass.—The Deutsche Metallarbeiter gives the following directions for bronzing brass: The articles, which must be free from grease and polished, are first immersed for half a minute in a cold solution of 10 grammes of potassium permanganate, 50 grammes of sulphate of iron and 5 grammes of hydrochloric acid in 1 liter of water. They are then washed off and dried in fine, soft saw dust. If the color has become too dark, or if a more reddish-brown color is required, the objects are immersed, immediately after they have been taken out of the liquid, for about one minute in a warm solution (60 deg. C.) of 10 grammes of chromic acid, 10 grammes of chloric acid, 10 grammes of potassium permanganate, and 50 grammes of sulphate of iron in 1 liter of water, and treated as above. By using the second liquid alone, a brighter, dark-yellow, or red-brown color is produced. The objects may afterward be heated in a drying oven, whereby the color is considerably improved.

Acid Test for Gold: Touchstone.—The ordinary ready method of ascertaining whether a piece of jewelry is made of gold consists in touching it with a glass stopper wetted with nitric acid, which leaves gold untouched, but colors base alloys blue from the formation of nitrate of copper. The "touchstone" sometimes used in testing is said to be a species of black basalt, obtained chiefly from Silesia. If a piece of gold be drawn across its surface, a golden streak is left, which is said to be not affected by moistening with nitric acid; while the streak left by brass or other base alloy would be rapidly dissolved by the acid. Experience enables an operator to determine by means of the touchstone pretty nearly the amount of gold present in an alloy, comparison being made with the streaks left by alloys of known composition. It is claimed that the fitness of the stone for this use arises from its easily abrading the metal, not being itself affected by nitric acid, and presenting a dark smooth ground adapted for exhibiting shades of color.—Pharmaceutical Era.

How to Pour Out Castor Oil.—Among a number of other good and practical kinks and ideas suggested by Mr. N. F. Ruhl in his paper read before the Pennsylvania Pharmaceutical Association, last summer, was the following:

Any one who has tried to pour castor oil from a square five-gallon can, when it is full, knows how difficult it is to avoid a mess. This, however, may be avoided by having a hole punched in the cap which screws on the can, and a tube, two inches long and three-fourths of an inch in diameter, soldered on. With a wire nail a hole is punched in the top of the can between the screw cap and the edge of the can. This will admit air while pouring. Resting the can on the counter with the screw cap tube to the rear, the can is carefully tilted forward with one hand and the shop bottle held in the other. In this way the bottle may be filled without spilling any of the oil and that, too, without a funnel. The writer much prefers to rest the can on the counter when pouring from a one or two-gallon square varnish can when filling shop bottles. With the opening to the rear, the can is likewise tilted forward slowly so as to allow the surface of the liquid to become "at rest." Even mobile liquids, such as spirits of turpentine, may be poured into shop bottles without a funnel. Of course, the main thing is that the can be lowered slowly, otherwise the first portion may spurt out over the bottle. With five-gallon round cans it is possible to fill shop bottles in the same manner by resting the can on a box or counter. When a funnel is used for non-greasy liquids, the funnel may be slightly raised with the thumb and little finger from the neck of the bottle, while holding the bottle by the neck between the middle and ring fingers, to allow egress of air.

Lithographic Ink.—Villon indicates the following composition, which gives good results:

Yellow wax	250 grammes
Mineral wax	250 grammes
Tallow	180 grammes
Rosin	200 grammes
Vaseline	100 grammes
Soap	80 grammes
Weak linseed oil varnish	500 grammes
Lamp black	100 grammes

First melt the mineral wax, then add the yellow wax, next the rosin, and heat one-quarter hour to 150 deg. C. to incorporate everything well.

The soap is introduced in thin leaves, and when it is completely dissolved, add the other materials.—Les Corps Gras Industriels.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Foreign Enterprise in Siberia.—Commercial Agent R. T. Greener sends the following from Vladivostock, December 29, 1902:

It should be noted by persons in the United States who are called on to invest in Siberian ventures that few are successful. It is not so difficult to get a St. Petersburg concession, if one has capital enough. But the outcome, whether for mining, fishing, hunting, or trading, has in few cases justified the outlay. It should be clearly understood that the Russian government does not offer inducements for these ventures, and that expensive formalities must be complied with.

Railway Car Plant in Mexico.—Consul W. W. Canada writes from Veracruz, February 16, 1903:

The federal government has authorized Mr. Isaac Hutchison to erect and operate a plant for the construction of freight and passenger cars, under the conditions named below:

Within six months full plans and descriptions of the buildings and machinery must be presented to the government, and the entire plant shall be completed and in working order within three years. The sum of at least $100,000 Mexican (about $40,000 gold) shall be invested in the proposed enterprise during the ten years for which this privilege is granted. Four scholars, to be selected by the government, shall be admitted to the shops to make themselves familiar with the working of the plant, and the works are to be open for visits from the pupils of the national schools at stated periods and under competent guidance. The sum of $10,000 must be deposited with the national bank as a guaranty for fulfillment of the concession. The government reserves the right to appoint inspectors. All the material for construction shall be admitted free of duty. The capital invested is to be free of direct taxation and only subject to the stamp revenue tax.

Meat-Canning Industry in Veracruz.—The following has been received from Consul W. W. Canada, under date of February 16, 1903:

The government of Veracruz has authorized Mr. Alfred Bishop Mason to establish a canning and preserving factory within the limits of the State. The place selected for the erection of buildings for killing beef cattle, sheep, goats, and hogs, as also the refrigerating plant for the meats and fish, is the town of San Antonio Tenejapa, County of Orizaba. As this is the first establishment of the kind in the State, and also on account of the large capital invested, the concern will be free of all taxation; but in case the products sold are in fresh, salted, or refrigerated condition, the regular license tax on the killing of cattle is to be collected. The construction of the plant is to be completed within two years. The State government agrees not to give similar privileges to any other like enterprise during the term of ten years.

Canadian Duty Wanted on Binder Twine.—Consul E. N. Gunsaulus, of Toronto, under date of February 26, 1903, quotes from the Canadian Manufacturer the following:

"Representatives of the eleven binder twine and cordage factories in Canada waited upon the ministers of customs and finance last week and asked for the imposition of a duty upon binder twine. Now that the control of the Philippines has passed into the hands of the United States, the American manufacturers are able to obtain their manila fiber at three-eighths of a cent per pound less than their Canadian competitors; consequently, the former are able to undersell the latter in the Canadian market. The Canadian manufacturers are therefore looking to the restoration of the duty to afford them relief from ruinous competition."

During the year 1902, adds the consul, Canada imported binder twine to the value of $1,752,859, and of this the United States supplied $1,683,772.

Poultry Exhibition at Rome.—Under date of February 11, 1903, Consul-General Hector de Castro, of Rome, transmits copies of the programme* and regulations of the poultry exhibition to be held in Rome from April 16 to 26, 1903, in connection with the International Congress of Agriculturists.† An invitation is extended to societies and parties interested in the improvement of poultry to participate in this exhibition. The entrance fee is 1.50 francs (29 cents) for every subject in all the categories except pigeons, which are taxed 1.50 francs (29 cents) per pair. Communications should be addressed to the Agricultural Committee of Rome, Place S. Stefano del Cacco, N. 26.

Mining Enterprises and Limited Companies of Bolivia.—Minister Sorsby transmits from La Paz translation of a recent decree of the Bolivian government relating to limited companies and mining enterprises doing business in Bolivia, which reads:

"Article 1. Limited companies and mining enterprises, be their owners private persons or associations of other denomination or class, are obliged to keep books, as indicated in article 32 of the mercantile code, and also a register of the fineness of the metals they export.

"Art. 2. The associations and enterprises designated in the foregoing article shall draw up their respective balance sheets and shall send two copies to the Minister of Finance and Industry or to the office of fiscal inspection within the forty days following the termination of the year, without omitting the publication and remittance to be effected by said associations in accordance with the supreme decree of March 25, 1887.

"Art. 3. Within the same period of forty days the payment of the fiscal tax of 2 per cent of the net profits must be made in the respective departmental treasury, in favor of the National Treasury.

"Art. 4. For the purposes of the foregoing article, net profits shall be understood to be the sum set apart for the payment of dividends—or rather the gains of the partners or owners, whether they reside within the Republic or abroad.

"Art. 5. The dispositions contained in articles 3 and 4 of the decree of March 25, 1887, are applicable to mining enterprises, whether they be owned by private persons or associations.

"Art. 6. The administrators of departmental treasuries are obliged, on their own responsibility, to give notice to the Minister of Finance of such associations or enterprises that have not paid the fiscal tax within the period stated in article 3 of this decree."

American College in Strasburg.—Consul J. I. Brittain writes from Strasburg, February 18, 1903:

The average American is beginning to learn that if we are to continue our advancement along commercial lines, we must give our boys a better knowledge of the modern languages. An American college has been established in Strasburg (the educational and commercial center of this consular district), the object of which, as set forth in a circular, is "to fit American boys for American universities in the actual European environments of spoken German and French." The number of pupils admitted to the school is limited to twenty. "Classes" and "forms" do not exist, nor under any circumstances do more than four boys hear the same recitation at the same time. The modern languages are taught by native teachers, resident at the school. Science and the English subjects are in charge of experienced American instructors. The school occupies a building of forty rooms, situated in the best part of the city, and has modern sanitary arrangements. A large playground and a boathouse, well supplied with training and racing boats, are near the building, thus affording ample facilities for athletic exercise. The principal of the school is David K. Goss, formerly superintendent of schools in Indianapolis.

Weaving Machinery for Japan.—Under date of February 10, 1903, Consul S. S. Lyon transmits from Kobé clipping from a local newspaper, as follows:

"Mr. Yamaguchi, an expert in the Department of Agriculture and Commerce, who in August last was sent to Europe and America to purchase weaving machines to be hired to weavers in this country, has returned home. Mr. Yamaguchi has spent some 35,000 yen ($17,430) in America and the same amount at Lyons, France. At Zurich, Switzerland, he bought machinery to the value of 15,000 yen ($7,470), and in Germany he spent 25,000 yen ($12,450), the purchases including dyeing and velvet-weaving machines. The American machines are to be loaned to the Ashikaga model weaving factory and those from France to the Kiryu model weaving factory. The French habutai-weaving machines will be lent to the Fukui weaving school and the dyeing and other machines to the Yonezawa model weaving factory, while the velvet-weaving machines will go to the Kyoto model weaving factory. The machines are expected to arrive next month."

Automobile Exposition at Brussels.—Consul G. W. Roosevelt reports from Brussels, February 17, 1903, that an international exposition of automobiles, cycles, and motor cycles was held February 7 to 16 in the Cinquantenaire Park, at Brussels. The extensive hall was illuminated by electricity and by Washington hanging lamps—a new system of illumination by ordinary petroleum, emitting intense light. There were 150 exhibits, ranging from the powerful truck of 20 or 40 horse power to the graceful voiturette of 6 or 8 horse power. One solidly constructed truck, which was immediately bought for the Kongo Free State, had a carrying capacity of 6 tons and hauling capacity of 6 additional tons; average speed per hour, 12 kilometers (7.45 miles). The consumption, either alcohol or petroleum, was 1 liter (1.05 quarts) for 3 kilometers (1.86 miles), and its capacity permitted a run of over 90 miles without refilling. The only really new device transformed the front or gearing wheels into motor wheels. A concealed mechanism operated the motor. The steering gear could be adjusted to any desired height, and the mechanism operating the forward motor could be attached to any carriage.

Congress for Applied Chemistry at Berlin.—The Department has received a note from the German embassy, Washington, dated March 4, 1903, stating that the Fifth International Congress for Applied Chemistry will be held in Berlin from June 2 to 8, 1903. The United States government is invited to send official delegates. Printed circulars for distribution to interested institutions are inclosed. Announcements of participation—also demands for information—should be addressed to the office of the Fifth International Congress for Applied Chemistry, 21 Marchstrasse, Charlottenburg. The assessment for membership is 20 marks ($4.76); ladies accompanying members, 15 marks ($3.57). The purpose of this congress is to promote the scientific and economical interests of chemical work by introducing uniform standard methods and regulations throughout the world. The first congress of this character was held at Brussels in 1894, and the fourth at Paris in 1900.

* Filed in the Bureau of Foreign Commerce, where it may be examined by parties interested.

† See Advance Sheets No. 1573 (February 17, 1903).

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The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

Tetter Ointment.—

Calomel	2 drachms
Dried alum, powdered	2 drachms
Lead carbonate	2 drachms
Oil of turpentine	2 drachms
Simple cerate	1½ ounces.

—N. E. Druggist.

Eucalyptus Toothpaste.—One hundred and sixty grammes precipitated chalk, 45 grammes soap-powder, 45 grammes wheaten starch, 1 gramme carmine, 30 drops oil of peppermint, 30 drops oil of geranium, 60 drops eucalyptus oil, 2 drops oil of cloves, 12 drops oil of anise mixed together and incorporated to a paste, with a mixture of equal parts of glycerine and spirit.—Pharm. Era.

Phosphate Baking Powder.—

Acid calcium phosphate, anhydrous	27 parts
Sodium carbonate	25 parts
Corn starch, enough to make	100 parts

Mix. The available amount of carbon dioxide yielded by this mixture is 12 per cent.—National Druggist.

A New Drink.—The following has been patented in Germany:

To 100 liters of water add from 10 to 15 kilogrammes of sugar, dissolve and add to the syrup thus formed an aqueous extract of 800 grammes of green or black tea. Add fresh beer or brewers' yeast, put in a warm place and let ferment. When fermentation has progressed to a certain point the liquid is cleared, and then bottled, corked and the corks tied down. The drink, which is said to be very pleasant, it is claimed by the patentee, is "healthier and cheaper than beer." Cocoa or cola leaves may be used instead of tea.—National Druggist.

Benzin Cleaning Emulsion.—

Castile soap, shaved	150 parts
Alcohol, 95 per cent	600 parts
Benzin	1000 parts
Oil of turpentine	100 parts

Dissolve the soap in 500 parts of the alcohol in the water-bath, remove from bath and add, little by little, one-half of the benzin. Mix the remaining alcohol, benzin and turpentine, and add it to the soap mixture, under constant agitation. If it is desired to give the cleaner more consistency, 25 parts of copal varnish may be added. Another:

Benzin	1000 parts
Soap, best Castile, rasped	30 parts
Water, sufficient.	

Dissolve the soap in 100 parts of water, by the aid of heat, and pour into a large bottle. Now add the benzin, a little at a time, vigorously shaking the bottle after each addition. If the emulsification shows a tendency to be retarded, add from 50 to 100 parts of warm water, all at once. After the emulsion has been made, set aside for five or six days to separate. At the end of that time, pour off any supernatant water, and put the residue in tin boxes for sale.—National Druggist.

Library Paste.—

Tragacanth, powdered	2 parts
White dextrin	1 part
Wheat flour	6 parts
Glycerin	1 part
Cold water	4 parts
Boiling water	40 parts

Over the tragacanth pour 16 parts of water in active ebullition, stirring it well, and set aside in a moderately warm place. Mix the wheat flour and dextrin with the cold water, stirring thoroughly, and add the mixture to the tragacanth. Pour the batter thus formed into the rest of the boiling water (24 parts) stirring constantly while doing. Add to the glycerin about ¼ of 1 part of salicylic acid (or sufficient of the substance to constitute about one-half of 1 per cent of the whole batch of paste) and pour the mixture into the boiling paste, and under constant stirring cook for four or five minutes. Remove from fire and pour into a receptacle for preserving, cover with a piece of bladder or oil skin, and tie down. When required for use take out as much as needed and tie up again. In this way the paste will keep sweet for a very long time. It is white, odorless (or with a faint, agreeable odor), and is a wonderful sticker, where paper or cloth only is concerned. The addition of 2 parts of gum arabic and 3 more parts of glycerin (4 parts in all), converts the product into an unrivaled label paste for glass. The substitution of good glue or isinglass for gum arabic, and the addition of 8 parts of sugar makes an all-around paste for use on wood, leather, metal.—National Druggist.

Furniture Polishing Cream.—

Beeswax	2500 parts
Potassium carbonate	25 parts
Oil of turpentine	4000 parts
Water, rain or distilled	4500 parts

Dissolve the potassium salt in 1500 parts of the water, add the wax, rasped or cut up, and boil together until the wax is partially saponified. Add sufficient water to replace that lost by evaporation, remove from the fire and stir until cold. Now add, little by little, and under constant stirring, the oil of turpentine, and continue to stir until a smooth homogeneous emulsion is obtained. When this occurs, add the remainder of the water at once and stir in. If desirable, a little oil of lavender or other essential oil may be used as a perfume. It should be added with or immediately after the oil of turpentine. If a color is desired, soak alkanet root in the oil of turpentine (about an ounce to the quart) before addition.

This paste is said by the Journal of the Austrian Pharmaceutical Association to be one of the best furniture polishes known. The directions are very simple—apply the paste as thinly as possible over the surface to be polished (which, of course, should be first washed with tepid suds, either alone, or, as many housewives prefer, carrying a little gasoline poured on the surface), then rub off with a soft woolen cloth, using "elbow grease q. s." in rubbing.—National Druggist.

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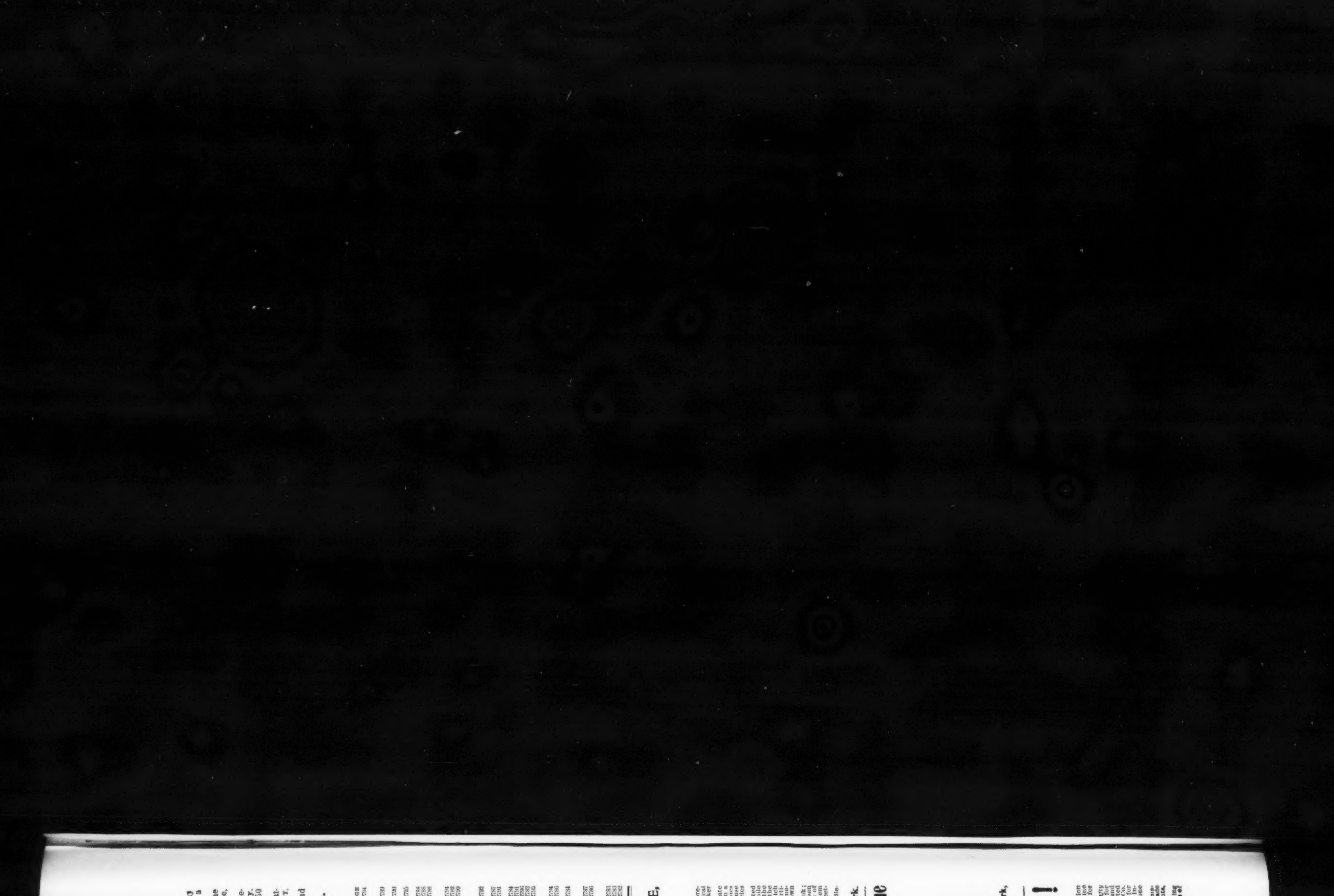
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